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Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

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Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

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Includes passenger and cargo air transport operations; and aircraft accidents.

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Includes cockpit and cabin display devices; and flight instruments.

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Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft.

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For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

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For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

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For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

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For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

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Includes space-based development of products and processes for commercial application.

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Includes engineering (general); communications and radar; electronics and electrical engineering; fluid mechanics and heat transfer; instrumentation and photography; lasers and masers; mechanical engineering; quality assurance and reliability; and structural mechanics.

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Includes human engineering; biotechnology; and space suits and protective clothing.

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Includes superconductivity.
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77 THERMODYNAMICS AND STATISTICAL PHYSICS 2737
Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law, political science, and space policy; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 2738
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 2739
Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS 2740
Includes cost effectiveness studies.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY 2740
Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 2740
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 2740
Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 ASTROPHYSICS 2741
Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics.*

91 LUNAR AND PLANETARY EXPLORATION 2742
Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

92 SOLAR PHYSICS 2743
Includes solar activity, solar flares, solar radiation and sunspots.
For related information see *93 Space Radiation.*

93 SPACE RADIATION 2743
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

99 GENERAL N.A.

Note: N.A. means that no abstracts were assigned to this category for this issue.

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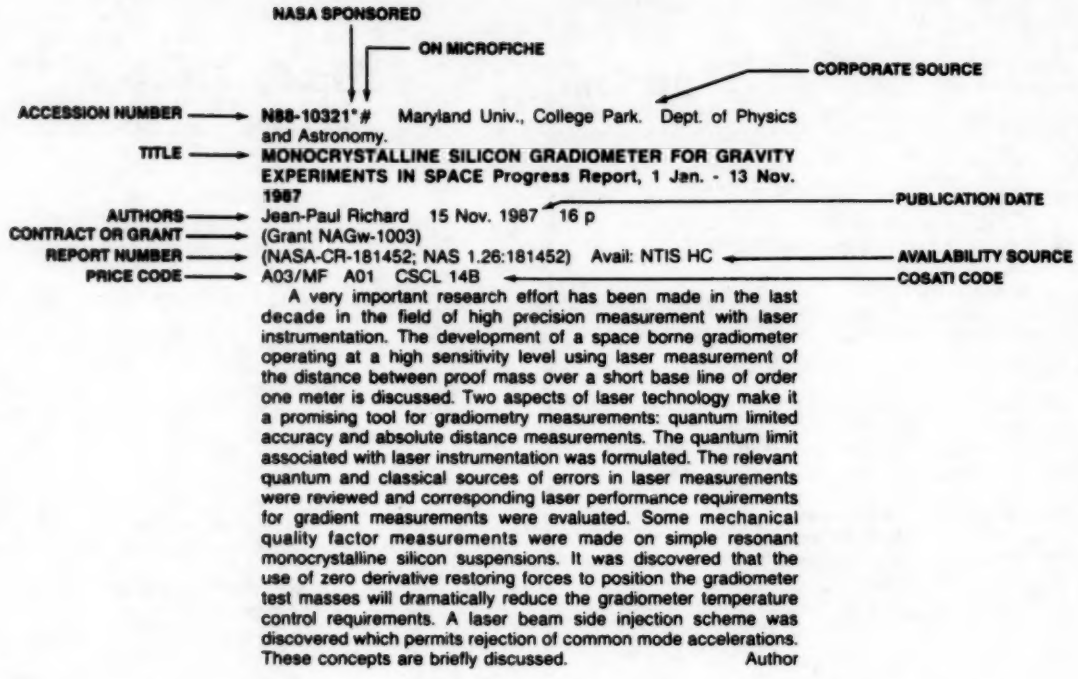
NASA SPONSORED
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CORPORATE SOURCE
ACCESSION NUMBER
N88-10321*# Maryland Univ., College Park. Dept. of Physics and Astronomy.
TITLE
MONOCRYSTALLINE SILICON GRADIOMETER FOR GRAVITY EXPERIMENTS IN SPACE Progress Report, 1 Jan. - 13 Nov. 1987
PUBLICATION DATE
AUTHORS
Jean-Paul Richard 15 Nov. 1987 16 p
CONTRACT OR GRANT
(Grant NAGw-1003)
REPORT NUMBER
(NASA-CR-181452; NAS 1.26:181452) Avail: NTIS HC
AVAILABILITY SOURCE
PRICE CODE
A03/MF A01 CSCL 14B
COSATI CODE
A very important research effort has been made in the last decade in the field of high precision measurement with laser instrumentation. The development of a space borne gradiometer operating at a high sensitivity level using laser measurement of the distance between proof mass over a short base line of order one meter is discussed. Two aspects of laser technology make it a promising tool for gradiometry measurements: quantum limited accuracy and absolute distance measurements. The quantum limit associated with laser instrumentation was formulated. The relevant quantum and classical sources of errors in laser measurements were reviewed and corresponding laser performance requirements for gradient measurements were evaluated. Some mechanical quality factor measurements were made on simple resonant monocrystalline silicon suspensions. It was discovered that the use of zero derivative restoring forces to position the gradiometer test masses will dramatically reduce the gradiometer temperature control requirements. A laser beam side injection scheme was discovered which permits rejection of common mode accelerations. These concepts are briefly discussed. Author

VOLUME 26 NUMBER 19 / OCTOBER 8, 1988

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N88-25431*# California Polytechnic State Univ., San Luis Obispo.
TAKEOFF PREDICTIONS FOR POWERED-LIFT AIRCRAFT Thesis
Douglas A. Wardwell and Doral R. Sandlin Jul. 1988 60 p
(Contract NCC2-236)
(NASA-CR-177491; NAS 1.26:177491) Avail: NTIS HC A04/MF A01 CSCL 01A

Takeoff predictions for powered-lift short takeoff (STO) and conventional takeoff (CTO) aircraft have been added to NASA Ames Research Center's Aircraft Synthesis (ACSYNT) code. The new computer code predicts the aircraft engine and nozzle settings required to achieve the minimum takeoff roll. As a test case, the code predicted takeoff ground rolls and nozzle settings for the YAV-8B Harrier that compared well with measured values. Brief analysis of takeoff performance for an Ejector, Remote Augmented Lift, Hybrid-Tandem Fan, and Vectored Thrust STO aircraft using the new routine will be presented. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N88-25432*# George Washington Univ., Washington, D.C. School of Engineering and Applied Science.
DRAG MEASUREMENTS ON A LAMINAR FLOW BODY OF REVOLUTION IN LANGLEY'S 13 INCH MAGNETIC SUSPENSION AND BALANCE SYSTEM M.S. Thesis
David A. Dress Apr. 1988 95 p Sponsored by NASA, Langley Research Center, Hampton, Va.
(NASA-CR-182909; NAS 1.26:182909) Avail: NTIS HC A05/MF A01 CSCL 01A

Low-speed wind tunnel drag force measurements were taken on a laminar flow body of revolution free of support interference. This body was tested at zero incidence in the NASA Langley 13 inch Magnetic Suspension and Balance System (MSBS). The primary objective of these tests was to substantiate the drag force measuring capabilities of the 13 inch MSBS. A secondary objective was to obtain support interference free drag measurements on an axisymmetric body of interest. Both objectives were met. The drag force calibrations and wind-on repeatability data provide a means of assessing the drag force measuring capabilities of the 13 inch MSBS. The measured drag coefficients for this body are of interest to researchers actively involved in designing minimum drag fuselage shapes. Additional investigations included: the effects of fixing transition; the effects of fins installed in the tail; surface flow visualizations using both liquid crystals and oil flow; and base pressure measurements using a one-channel telemetry system. Two drag prediction codes were used to assess their usefulness in estimating overall body drag. These theoretical results did not compare well with the measured values because of the following: incorrect or non-existent modeling of a laminar separation bubble on the body and incorrect of non-existent estimates of base pressure drag. Author

N88-25433 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
NUMERICAL SIMULATION OF COMPRESSIBLE HOMOGENEOUS TURBULENCE: EFFECTS OF FLUID COMPRESSIBILITY Final Report
K. Dang Mar. 1987 54 p In FRENCH Original language document was announced as N87-18043 Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France
(PB88-127154) Avail: NTIS HC E04/MF E04 CSCL 01A

Numerical simulation studies of compressible, homogeneous, turbulent flow were performed. The restriction of homogeneous turbulence allows periodic solutions and hence the use of fast Fourier transformations. Various time schemes were adapted to the Burger equation and then to the Navier-Stokes equations. A Fourier spectral method was used for the space discretization. Application in 2-D (square geometry) and 3-D (cube geometry) configurations are described. The simulation of flows with constant mean velocity field gradient was analyzed and applied to shear flow. Simulations where the initial velocity field is a superposition of a mean profile and a turbulent disturbance approximating a jet type flow are presented. GRA

N88-25434# Lawrence Livermore National Lab., Calif.
ESTIMATION OF BALLOON POSITION FROM WIND DATA
L. C. Ng and M. F. Kelly Mar. 1988 43 p
(Contract W-7405-eng-48)
(DE88-008968; UCID-21371) Avail: NTIS HC A03/MF A01

The report summarized the mathematical algorithm and the computed results developed for the prediction of a balloon's position uncertainty as a function of time from a given statistical wind velocity profile. The predicted results were used for mission plannings in support of a recent ship launch ballon observation experiment. DOE

N88-25435*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CORRELATIONS OF VELOCITY AND TEMPERATURE FLUCTUATIONS IN THE STAGNATION-POINT FLOW OF CIRCULAR CYLINDER IN TURBULENT FLOW
Chi R. Wang 1988 22 p Presented at the 1988 Winter Annual Meeting of the American Society of Mechanical Engineers, Chicago, Ill., 28 Nov. - 2 Dec. 1988
(NASA-TM-100930; E-4201; NAS 1.15:100930) Avail: NTIS HC A03/MF A01 CSCL 01A

Boundary layer flow and turbulence transport analyses to study the influence of the free-stream turbulence on the surface heat transfer rate and the skin friction around the stagnation point of a circular cylinder in a turbulent flow are presented. The analyses are formulated with the turbulent boundary layer equations, the Reynolds stress transport equations and the k - epsilon two-equation turbulence modeling. The analyses are used to calculate the time-averaged turbulence double correlations, the mean flow properties, the surface heat transfer rate and the skin friction with an isotropic turbulence in the freestream. The analytical results are described and compared with the existing experimental measurements. Depending on the free-stream turbulence

properties, the turbulence kinetic energy can increase or decrease as the flow moves toward the surface. However, the turbulence kinetic energy induces large Reynolds normal stresses at the boundary layer edge. The Reynolds normal stresses change the boundary layer profiles of the time-averaged double correlations of the velocity and temperature fluctuations, the surface heat transfer rate and the skin friction. The free-stream turbulence dissipation rate can affect the stagnation-point heat transfer rate but the influence of the free-stream temperature fluctuation on the heat transfer rate is insignificant. Author

N88-25436 Oklahoma Univ., Norman.
AERODYNAMICS OF LIFTING BODIES WITH COMBINED TRANSVERSE AND LONGITUDINAL CURVATURE Ph.D. Thesis
Sheam-Chyun Lin 1987 125 p
Avail: Univ. Microfilms Order No. DA8729877

Explicit, closed form, approximate analytical results were obtained for hypersonic flow past a body whose cross section deviates slightly from a right circular cone as a result of combined transverse and longitudinal curvature. The results are developed in the framework of hypersonic small disturbance theory and presented in similarity form. The analytic nature of the solution is particularly suitable for conducting parametric design studies of lifting body configurations. By means of these flow field solutions, a new class of waverider configurations can be constructed. The lift and drag and other pertinent characteristics can be determined by means of quadratures. An average skin friction coefficient is used to take the viscous drag into account and to be studied parametrically in a rational basis. The results indicate that combined longitudinal and transverse curvature can be used effectively to efficiently integrate volumetric, propulsion, and aerodynamic requirements for a variety of hypersonic vehicles. Dissert. Abstr.

N88-25437 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
DEVELOPMENT OF A METHOD OF CALCULATING UNSTABLE FLOWS OF CASCADES SEPARATED AT THE LEADING EDGE
P. Girodroux-Lavigne and J. C. LeBalleur Jan. 1987 34 p In FRENCH Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France
(PB87-228714; ONERA-RSF-37/1621-RY) Avail: NTIS HC E04/MF E04; copy not available from STI Facility CSCL 01A

A numerical method of viscous/nonviscous interaction earmarked for the calculation of separated flows on sharp leading edges was embarked upon for the unstable range of plane cascades. The first positive results were obtained for the stable range in the case of a plane plate in incidence placed in a channel. The calculations are compared with the experiments. The good capacity of the numerical method as well as that of the model representation of average viscous flow are demonstrated by calculations of pressure and of velocity profiles in the separated viscous layer. The quantitative results are encouraging. They are dependent upon the usual limitations connected with a model representation of turbulence. Author

N88-25438*# National Aeronautics and Space Administration, Washington, D.C.
A CHARACTERISTIC METHOD FOR CALCULATING THE GENERALIZED FLAT FLUTTER AERODYNAMIC FORCES
Ingolf Teipel Jun. 1988 17 p Transl. into ENGLISH from Ein Charakteristikenverfahren zur Berechnung der Verallgemeinerten Ebenen Flatterluftkraefte, Zeitschrist fuer Flugwissenschaften (Federal Republic of Germany), v. 10, 1962 p 374-379 Transl. by SCITRAN, Inc., Santa Barbara, Calif. Original document prepared by Inst. for Theoretical Gasdynamics of the German Test Facility for Aerodynamics and Space Flight (DVL), Aachen, (Federal Republic of Germany)
(Contract NASw-4307)
(NASA-TT-20300; NAS 1.77:20300) Avail: NTIS HC A03/MF A01 CSCL 01A

The supersonic 2-D flow past an oscillating profile is calculated by means of a method of characteristics. The deformation of the wing chord is considered as well. In order to linearize the problem, amplitudes are assumed small. A linear method of characteristics is obtained with six dependent variables, namely amplitude and phase of the velocity components and of the pressure. Besides the lateral and rotating motion of the wing, two further mode shapes of the uniform unrestrained beam are given. The calculation is carried out for different Mach numbers and different reduced frequencies. Author

N88-25439*# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
THE EXPERIMENTAL VERIFICATION OF WALL MOVEMENT INFLUENCE COEFFICIENTS FOR AN ADAPTIVE WALLED TEST SECTION
G. Neal Jul. 1988 33 p
(Grant NsG-7172)
(NASA-CR-181681; NAS 1.26:181681; AASU-87-4) Avail: NTIS HC A03/MF A01 CSCL 01A

Flexible walled wind tunnels have for some time been used to reduce wall interference effects at the model. A necessary part of the 3-D wall adjustment strategy being developed for the Transonic Self-Streamlining Wind Tunnel (TSWT) of Southampton University is the use of influence coefficients. The influence of a wall bump on the centerline flow in TSWT has been calculated theoretically using a streamline curvature program. This report details the experimental verification of these influence coefficients and concludes that it is valid to use the theoretically determined values in 3-D model testing. Author

N88-25440# Yale Univ., New Haven, Conn.
AERODYNAMIC FOCUSING OF PARTICLES AND HEAVY MOLECULES Annual Report No. 1
J. F. delaMora 16 Feb. 1988 12 p
(Contract DE-FG02-87ER-13750)
(DE88-007145; DOE/ER-13750/1) Avail: NTIS HC A03/MF A01

Our first goal was to investigate the phenomenon of aerodynamic focusing in supersonic free jets, in order to assess its potential technological uses in direct writing and other energy-related applications. Our research program divides itself naturally into two chapters: on focusing microscopic particles, and on focusing individual molecules of heavy vapors carried in jets of He and H2. In both lines we combine diverse experimental and theoretical methods of attack. DOE

N88-25441*# Vigyan Research Associates, Inc., Hampton, Va.
A LOW SPEED WIND TUNNEL INVESTIGATION OF REYNOLDS NUMBER EFFECTS ON A 60-DEG SWEPT WING CONFIGURATION WITH LEADING AND TRAILING EDGE FLAPS
Dhanvada M. Rao and Keith D. Hoffler Aug. 1988 69 p
(Contract NAS1-17919)
(NASA-CR-181684; NAS 1.26:181684) Avail: NTIS HC A04/MF A01 CSCL 01A

A low-speed wind tunnel test was performed to investigate Reynolds number effects on the aerodynamic characteristics of a supersonic cruise wing concept model with a 60-deg swept wing incorporating leading-edge and trailing-edge flap deflections. The Reynolds number ranged from 0.3 to 1.6 x 10 to the 6th, and corresponding Mach numbers from .05 to 0.3. The objective was to define a threshold Reynolds number above which the flap aerodynamics basically remained unchanged, and also to generate a data base useful for validating theoretical predictions for the Reynolds number effects on flap performance. This report documents the test procedures used and the basic data acquired in the investigation. Author

N88-25442*# Southampton Univ. (England).
EMPTY TEST SECTION STREAMLINING OF THE TRANSONIC SELF-STREAMLINING WIND TUNNEL FITTED WITH NEW WALLS
M. C. Lewis Jul. 1988 31 p

(Grant NsG-7172)
(NASA-CR-181680; NAS 1.26:181680; AASU-Memo-86/10)
Avail: NTIS HC A03/MF A01 CSCL 01A

The original flexible top and bottom walls of the Transonic Self-Streamlining Wind Tunnel (TSWT), at the University of Southampton, have been replaced with new walls featuring a larger number of static pressure tappings and detailed mechanical improvements. This report describes the streamling method, results, and conclusions of a series of tests aimed at defining sets of aerodynamically straight wall contours for the new flexible walls. This procedure is a necessary prelude to model testing. The quality of data obtained compares favorably with the aerodynamically straight data obtained with the old walls. No operational difficulties were experienced with the new walls. Author

N88-25443*# Wichita State Univ., Kans. Inst. for Aviation Research.
CALIBRATION OF AVERAGING TOTAL PRESSURE FLIGHT WAKE RAKE AND NATURAL-LAMINAR-FLOW AIRFOIL DRAG CERTIFICATION
E. Irani and M. H. Snyder Feb. 1988 26 p
(NASA-CR-181630; NAS 1.26:181630; AR-87-1) Avail: NTIS HC A03/MF A01 CSCL 01A

An averaging total pressure wake rake used by the Cessna Aircraft Company in flight tests of a modified 210 airplane with a laminar flow wing was calibrated in wind tunnel tests against a five-tube pressure probe. The model generating the wake was a full-scale model of the Cessna airplane wing. Indications of drag trends were the same for both instruments. Author

N88-25444*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PARAMETRIC FLUTTER STUDIES OF AN ARROW-WING CONFIGURATION: SOME EARLY RESULTS
Michael H. Durham, Stanley R. Cole, F. W. Cazier, Jr., Donald F. Keller, Ellen C. Parker, and W. Keats Wilkie (Army Aerostructures Directorate, Hampton, Va.) May 1988 22 p Presented at the Aerospace Flutter and Dynamics Council Meeting, Las Vegas, Nev., 28-30 Oct. 1987
(NASA-TM-100608; NAS 1.15:100608) Avail: NTIS HC A03/MF A01 CSCL 01A

Some early experimental results from a combined experimental and analytical study being conducted at NASA-Langley of the transonic flutter characterisitics of a generic arrow wing configuration are presented. The planned study includes the parametric variation of a variety of structural and geometric characteristics. Presented here are flutter results of the basic arrow wing, for the basic wing with the addition of two simulated lower-surface-mounted engine nacelles, and for the basic wing with the addition of both the fin and the engine nacelles. Author

N88-25445*# Avco-Everett Research Lab., Mass.
IMPROVED NUMERICAL METHODS FOR TURBULENT VISCOUS RECIRCULATING FLOWS Final Report
A. Turan and J. P. VanDoormaal Jul. 1988 245 p
(Contract NAS3-24351)
(NASA-CR-180852; NAS 1.26:180852) Avail: NTIS HC A11/MF A01 CSCL 01A

The performance of discrete methods for the prediction of fluid flows can be enhanced by improving the convergence rate of solvers and by increasing the accuracy of the discrete representation of the equations of motion. This report evaluates the gains in solver performance that are available when various acceleration methods are applied. Various discretizations are also examined and two are recommended because of their accuracy and robustness. Insertion of the improved discretization and solver accelerator into a TEACH mode, that has been widely applied to combustor flows, illustrates the substantial gains to be achieved. Author

N88-25446*# National Aeronautics and Space Administration, Washington, D.C.
CASCADES WITH HARMONICALLY OSCILLATING BLADES IN SUPERSONIC FLOW Thesis
Franz-Konrad Vogeler Aug. 1988 141 p Transl. into ENGLISH of Gitter mit Harmonisch Schwingenden Schaufeln in Ueberschallstroemung, Aachen (Federal Republic of Germany), 1983 p 1-134 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
Original document was prepared by Rheinisch-Westfalischen Technischen Hochschule
(Contract NASw-4307)
(NASA-TT-20323; NAS 1.77:20323) Avail: NTIS HC A07/MF A01 CSCL 01A

A harmonically oscillating blade cascade with thickness influence at the blades in supersonic flow was theoretically and experimentally examined. For this, a characteristic method from the literature for nonlinear nonstationary, transonic potential equations of small disturbances was redeveloped and programmed. A program description is extant as a non-published report. To check these calculations, fluctuating pressure distributions were measured on an oscillating single blade and cascade behavior examined in supersonic flow. Author

N88-25624# Joint Publications Research Service, Arlington, Va.
AERODYNAMIC ANALYSIS OF NATURAL LAMINAR FLOW AIRFOIL
N. Kawai and N. Hirose *In its* JPRS Report: Science and Technology. Japan 4 May 1988 p 51-54 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jan. 1988 p 5-6 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

N88-25632*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL SIMULATIONS OF AERODYNAMIC CONTRIBUTION OF FLOWS ABOUT A SPACE-PLANE-TYPE CONFIGURATION
Kisa Matsushima, Susume Takanashi, Kozo Fujii (National Aerospace Lab., Tokyo, Japan), and Shigeru Obayashi *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 13-18 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25633# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATIONS OF FLOW AROUND SHUTTLE ORBITER
Satoru Ogawa, Tomiko Ishiguro, and Yoko Takakura (Fujitsu Ltd., Tokyo, Japan) *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 19-28 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25636# Nagoya Univ. (Japan).
NUMERICAL CALCULATION OF SUPERSONIC FLOW BY THE PNS EQUATIONS
Michiru Yasuhara and Yoshiaki Nakamura *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 43-48 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25637# Fuji Heavy Industries Ltd., Utsunomiya (Japan).
NAVIER-STOKES ANALYSIS OF TRANSONIC TRANSPORT AIRCRAFT EMPENNAGE
Yasuhiro Koshioka, Keisuke Kamo, and Kanichi Amano (Japan Aircraft Development Corp., Tokyo.) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 49-54 In JAPANESE;

ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25638# Kyoto Univ. (Japan). Dept. of Engineering.
NUMERICAL SOLUTIONS OF THE EULER EQUATIONS FOR THE FLOW FIELD AROUND COUNTER-ROTATING PROPELLERS
Makoto Kobayakawa and Masahiro Nakao (Mitsubishi Heavy-Industries Ltd., Nagoya, Japan) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 55-63 In JAPANESE; ENGLISH summary Original language document was announced in IAA as A88-13544 (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25639# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
NUMERICAL SIMULATION OF SUPERSONIC FREE-JETS
Ryuji Ishii, Takuya Matsuda, Yoshikuni Umeda, Atsuhiko Yasuda, Keisuke Sawada, and Eiji Shima (Kawasaki Heavy Industries Ltd., Kagamihara, Japan) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 65-71 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25640# Tokyo Univ. (Japan). Inst. of Computational Fluid Dynamics.
COMPUTATION OF FLOW AROUND NACA0012 AIRFOIL AT HIGH ANGLE OF ATTACK
Yoshifumi Shida and Kunio Kuwahara *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 73-79 In JAPANESE; ENGLISH summary Previously announced in IAA as A87-42448 (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25641# National Aerospace Lab., Tokyo (Japan).
AERODYNAMIC SIMULATION FOR COMPLETE ASKA AIRCRAFT CONFIGURATION
Susumu Takanashi and Keisuke Sawada (Kawasaki Heavy Industries Ltd., Kagamihara, Japan) *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 81-84 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25642*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL SIMULATION OF VISCOUS FLOWS OVER TRANSONIC AIRCRAFT CONFIGURATIONS
Susumu Takanashi, Masahiro Yoshida, Kozo Fujii, Kisa Matsushima (Fujitsu Ltd., Tokyo, Japan), and Shigeru Obayashi *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 85-89 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25643# National Aerospace Lab., Tokyo (Japan).
CALCULATIONS OF UNSTEADY AERODYNAMICS FOR A FULL AIRCRAFT CONFIGURATION USING BOUNDARY ELEMENT METHOD
Mitsunori Yanagizawa, Yoshiyuki Morita, and Shigefumi Tatsumi (Mitsubishi Heavy-Industries Ltd., Nagoya, Japan) *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 91-101 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25644# National Aerospace Lab., Tokyo (Japan).
RAREFIED GAS NUMERICAL WIND TUNNEL 3. UNIVERSAL CODE FOR THREE DIMENSIONAL BODIES
Katsuhisa Koura, Kinuyo Nakamura, Toshio Isobe, Kazuyo Suematsu, Masayuki Hatakeyama, and Toshiyuki Shimoji (Facom Hitac Co. Ltd., Japan) *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 103-107 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25648# Tohoku Univ., Sendai (Japan). Inst. of High Speed Mechanics.
NUMERICAL SIMULATION OF THE SHOCK TUBE FLOWS BY TVD SCHEME
Katsuhiro Itoh and Kazuyoshi Takayama *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 129-136 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25649# National Aerospace Lab., Tokyo (Japan).
NUMERICAL CALCULATION OF THREE DIMENSIONAL FLOW BY TVD SCHEME
Tomiko Ishiguro, Satoru Ogawa, and Yoko Takakura (Fujitsu Ltd., Tokyo, Japan) *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 137-146 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25665# Tsukuba Univ. (Japan). Inst. of Engineering Mechanics.
GRID GENERATION OF A HELICOPTER ROTARY-WING
Alain Carcasses and Y. Yoshizawa *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 247-253 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N88-25447*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
RADIATION SAFETY IN COMMERCIAL AIR TRAFFIC
John W. Wilson and Lawrence W. Townsend [1988] 8 p
(NASA-TM-101156; NAS 1.15:101156) Avail: NTIS HC A02/MF A01 CSCL 01C

A recalculation of radiation dose rates in the stratosphere indicates that near 45,000 ft. the level is 1 to 1.6 m-rem/hour depending on solar activity. Consequently, flight crews operating at that height should be considered radiation workers with respect to safety level calculations. Uncertainties are introduced by the difficulty in ascertaining how many hours flight crews actually spend at that altitude and by the unresolved effects of galactic heavy ion collisions on the atmospheric neutron spectrum. J.P.B.

N88-25448# Events Analysis, Inc., Oakton, Va.
CURRENT FIRE SAFETY DESIGN ASPECTS OF COMMUTER AIRCRAFT Final Report
Richard Clarke, Deborah Kane, and Carla Stewart Mar. 1988 85 p
(Contract DTFA03-86-C-00062)
(DOT/FAA/CT-87/32) Avail: NTIS HC A05/MF A01

Fire safety systems, cabin design and materials in cabin areas of ten common commuter aircraft are described. The trend in

these commuter aircraft is increasing sophistication in application of materials similar to those in large commercial aircraft. Among the ten aircraft two are older, piston powered aircraft, simple in design and materials applications. Of the other larger eight aircraft, two are no longer delivered. Four newer and larger designs feature large, separate baggage compartments. Only two aircraft have overhead storage bins. One aircraft has a large interior with standing headroom. The others are much more compact, with interior storage limited to bins at the entry point. Thermoplastics and composite materials are used in the newer aircraft. Each aircraft originally was equipped with polyurethane cushions; currently, operators and manufacturers are protecting cushions with fire blocking materials. Piston powered aircraft use gasoline cabin heaters and ram cooling airflow. The other eight aircraft are turboprop using engine bleed air for cabin heating and cooling. Six aircraft are unpressurized and four are pressurized. Author

N88-25449# National Transportation Safety Board, Washington, D. C.
AIRCRAFT ACCIDENT REPORT: NORTHWEST AIRLINES, INC., MCDONNELL DOUGLAS DC-9-82, N312RC, DETROIT METROPOLITAN WAYNE COUNTY AIRPORT, ROMULUS, MICHIGAN, AUGUST 16, 1987
10 May 1988 143 p
(PB88-910406; NTSB/AAR-88/05) Avail: NTIS HC A07/MF A01 CSCL 01C

At 2046 EDT on 16 August 1987, Northwest Airlines, Inc., flight 255 crashed shortly after taking off from runway 3 center at the Detroit Wayne County Airport, Romulus, Michigan. Flight 255, a McDonnell Douglas DC-9-82, U.S. Registry N312RC, was a regularly scheduled passenger flight and was en route to Phoenix, Arizona. According to witnesses, flight 255 began its takeoff rotation about 1,200 to 1,500 feet from the end of the runway and lifted off near the end of the runway. After liftoff, the wings of the airplane rolled to the left and the right about 35 deg in each direction. The plane collided with the obstacles northeast of the runway when the left wing struck a light pole located 2,760 feet beyond the end of the runway. Thereafter the plane struck other light poles, the roof of a car rental facility, and then the ground. It continued to slide along a path aligned generally with the extended centerline of the takeoff runway. The airplane broke up as it slid across the ground and postimpact fires erupted along the wreckage path. Aboard Flight 255, 148 passengers and 6 crewmembers were killed; 1 passenger, a 4-year-old was seriously injured but survived. On the ground, two persons were killed, one seriously injured, and four suffered minor injuries. The National Transportation Safety Board determines that the probable cause of the accident was the flightcrew's failure to use the taxi checklist to ensure that the flaps and slats were extended for takeoff. Contributing to the accident was the absence of electrical power to the airplane takeoff warning system which thus did not warn the flightcrew that the airplane was not configured properly for takeoff. The reason for the absence of electrical power could not be determined. Author

N88-25450# National Transportation Safety Board, Washington, D. C.
AIRCRAFT ACCIDENT REPORT: AIR NEW ORLEANS, DBA CONTINENTAL EXPRESS FLIGHT 962 BRITISH AEROSPACE 3101 (JETSTREAM 31), N331CY, NEW ORLEANS INTERNATIONAL AIRPORT, KENNER, LOUISIANA, MAY 26, 1987
31 May 1988 63 p
(PB88-910408; NTSB/AAR-88/06) Avail: NTIS HC A04/MF A01 CSCL 01C

On 26 May 1987, at 1645 central daylight time, Air New Orleans, doing business as Continental Express flight 962, departed runway 19 at New Orleans International Airport on a scheduled commuter flight to Eglin AFB, Fla. There were two pilots and nine passengers. As the airplane reached an altitude between 150 and 200 feet, the crew felt a severe yawing motion and observed the engine torque fluctuate erratically. The captain proceeded to make an emergency landing in the departure overrun of runway 19. Follow one bounce and final touchdown, maximum braking and full reverse thrust were applied. The airplane then rolled off the overrun, across an airport access road, through an airport security fence, through a concrete highway barrier, and across a highway. The airplane struck several vehicles on the roadway during the accident sequence. Two passengers suffered serious injuries. In addition, both pilots, seven passengers, and two occupants of ground vehicles received minor injuries. The airplane was destroyed. Author

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

No abstracts in this category.

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.* For land transportation vehicles see *85 Urban Technology and Transportation.*

N88-25451# Marine Corps, Washington, D. C.
REQUIRED OPERATIONAL CAPACITY FOR A 7-1/2 TON CAPACITY, AIR MOBILE CRANE (AMC)
Ray M. Franklin 24 Nov. 1987 14 p
(AD-A192023; USM-ROC-LOG-215.1.7) Avail: NTIS HC A03/MF A01 CSCL 13C

The Marine Corps has a requirement for an Air Mobile Crane capable of lifting 7 1/2 tons minimum and swinging 360 degrees while on outriggers. The AMC will be required to drive-on, drive-off a C130 aircraft fully assembled and will be of the rough-terrain style of cranes that feature rubber tires and a hydraulic boom. The AMC will be required to arrive with the Fly-In Echelon (FIE) and operate within the Ammunition Supply Point (ASP), on and off airfield runways, and over unprepared and uneven surfaces to include sand, snow, and mud. GRA

N88-25452*# Lockheed-California Co., Burbank. Structures and Materials Lab.
FUEL CONTAINMENT AND DAMAGE TOLERANCE IN LARGE COMPOSITE PRIMARY AIRCRAFT STRUCTURES. PHASE 2: TESTING
J. P. Sandifer, A. Denny, and M. A. Wood Apr. 1985 278 p
(Contract NAS1-16856)
(NASA-CR-172519; NAS 1.26:172519) Avail: NTIS HC A13/MF A01 CSCL 01C

Technical issues associated with fuel containment and damage tolerance of composite wing structures for transport aircraft were investigated. Material evaluation tests were conducted on two toughened resin composites: Celion/HX1504 and Celion/5245. These consisted of impact, tension, compression, edge delamination, and double cantilever beam tests. Another test series was conducted on graphite/epoxy box beams simulating a wing cover to spar cap joint configuration of a pressurized fuel tank. These tests evaluated the effectiveness of sealing methods with various fastener types and spacings under fatigue loading and with pressurized fuel. Another test series evaluated the ability of the selected coatings, film, and materials to prevent fuel leakage through 32-ply AS4/2220-1 laminates at various impact energy

levels. To verify the structural integrity of the technology demonstration article structural details, tests were conducted on blade stiffened panels and sections. Compression tests were performed on undamaged and impacted stiffened AS4/2220-1 panels and smaller element tests to evaluate stiffener pull-off, side load and failsafe properties. Compression tests were also performed on panels subjected to Zone 2 lightning strikes. All of these data were integrated into a demonstration article representing a moderately loaded area of a transport wing. This test combined lightning strike, pressurized fuel, impact, impact repair, fatigue and residual strength. M.G.

N88-25453*# Systems Control Technology, Inc., Arlington, Va.
ZERO/ZERO ROTORCRAFT CERTIFICATION ISSUES. VOLUME 1: EXECUTIVE SUMMARY Final Report
Richard J. Adams Jul. 1988 33 p
(Contract NAS2-12478)
(NASA-CR-177483-Vol-1; NAS 1.26:177483-Vol-1; DOT/FAA/PS-88/8-Vol-1; DOT/FAA/DS-88/2-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 01C

This report analyzes the Zero/Zero Rotorcraft Certification Issues from the perspectives of manufacturers, operators, researchers and the FAA. The basic premise behind this analysis is the zero/zero, or at least extremely low visibility, rotorcraft operations are feasible today from both a technological and an operational standpoint. The questions and issues that need to be resolved are: What certification requirements do we need to ensure safety. Can we develop procedures which capitalize on the performance and maneuvering capabilities unique to rotorcraft. Will exptremely low visibility operations be economically feasible. This is Volume 1 of three. It provides an overview of the Certification Issues Forum held in Phoenix, Arizona in August of 1987. It presents a consensus of 48 experts from government, manufacturer, and research communities on 50 specific Certification Issues. The topics of Operational Requirements, Procedures, Airworthiness, and Engineering Capabilities are discussed. Author

N88-25454*# Systems Control Technology, Inc., Arlington, Va.
ZERO/ZERO ROTORCRAFT CERTIFICATION ISSUES. VOLUME 2: PLENARY SESSION PRESENTATIONS Final Report
Richard J. Adams Jul. 1988 84 p
(Contract NAS2-12478)
(NASA-CR-177483-Vol-2; NAS 1.26:177483-Vol-2; DOT/FAA/DS-88/2-Vol-2; DOT/FAA/PS-88/8-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 01C

This report analyzes the Zero/Zero Rotorcraft Certification Issues from the perspectives of manufacturers, operators, researchers and the FAA. The basic premise behind this analysis is that zero/zero, or at least extremely low visibility, rotorcraft operations are feasible today from both a technological and an operational standpoint. The questions and issues that need to be resolved are: What certification requirements do we need to ensure safety. Can we develop procedures which capitalize on the performance and maneuvering capabilities unique to rotorcraft. Will extremely low visibility operations be economically feasible. This is Volume 2 of three. It presents the operator perspectives (system needs), applicable technology and zero/zero concepts developed in the first 12 months of research of this project. Author

N88-25455*# Systems Control Technology, Inc., Arlington, Va.
ZERO/ZERO ROTORCRAFT CERTIFICATION ISSUES. VOLUME 3: WORKING GROUP RESULTS Final Report
Richard J. Adams Jul. 1988 62 p
(Contract NAS2-12478)
(NASA-CR-177483-Vol-3; NAS 1.26:177483-Vol-3; DOT/FAA/DS-88/2-Vol-3; DOT/FAA/PS-88/8-Vol-3) Avail: NTIS HC A04/MF A01 CSCL 01C

This report analyzes the Zero/Zero Rotorcraft Certification Issues from the perspectives of manufacturers, operators, researchers and the FAA. The basic premise behind this analysis is that zero/zero, or at least extremely low visibility, rotorcraft operations are feasible today from both a technological and an operational standpoint. The questions and issues that need to be resolved are: What certification requirements do we need to ensure safety. Can we develop procedures which capitalize on the performance and maneuvering capabilities unique to rotorcraft. Will extremely low visibility operations be economically feasible. This is Volume 3 of three. It provides the issue-by-issue deliberations of the experts involved in the Working Groups assigned to deal with them in the Issues Forum. Author

N88-25627# Joint Publications Research Service, Arlington, Va.
VIBRATION TESTING OF ACT FUSELAGE
In its JPRS Report: Science and Technology. Japan 4 May 1988 p 58-59 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jan. 1988 p 10-11 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N88-25456# National Bureau of Standards, Boulder, Colo. Electromagnetic Fields Div.
AIRCRAFT FIELD DEGRADATION AND ELECTROMAGNETIC COMPATIBILITY
K. H. Cavcey and D. S. Friday Jan. 1988 100 p Sponsored by Army Aviation Systems Command, St. Louis, Mo.
(PB88-183975; NBSIR-88/3083) Avail: NTIS HC A05/MF A01 CSCL 01D

The paper discusses the first tests undertaken to study the problem of field degradation in army aircraft (helicopters and one fixed wing airplane) due to the deterioration of electronic and electrical systems. The electromagnetic compatibility (EMC) of such systems was investigated by passive measurement of the aircraft as a collection of radio frequency sources. Methods for detection of these sources were developed that included sensitivity to both stationary and nonstationary noise that existed. The collected data were studied to see if there existed any obvious factors derived from the data that one could use to correct potential problems that might affect flight safety. Emphasis was placed upon making such test methods appropriate, inexpensive, and easily performed by army field personnel. In addition, applications to quality control or acceptance testing, as related to the Environmental Stress Screening (ESS) program, were examined. GRA

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N88-25457# Air Force Occupational and Environmental Health Lab., Brooks AFB, Tex.
FIRST ARTICLE NOISE SURVEY OF THE A/F32T-9 LARGE TURBO FAN ENGINE ENCLOSED NOISE SUPPRESSOR SYSTEM, FAR-FIELD NOISE, ELLSWORTH AFB, SOUTH DAKOTA Final Report, period ending 13 Oct. 1987
Ali Y. Ali Feb. 1988 274 p
(AD-A191938; USAFOEHL-88-018EH0060ANA) Avail: NTIS HC A12/MF A01 CSCL 21E

The A/F32T-9 Large Turbo Fan Engine, Enclosed Noise Suppressor System (T-9 NSS) at Ellsworth AFB SD was surveyed to determine noise levels at 100 meters (m). With an F101 engine operating at afterburner power the highest measured Overall Sound

Level, A-Weighted (OASLA) was 78.4 dB(A). The measured OASLA values exceeded the 77 dB(A) criterion at only 7 of the 18 sampling positions at a range from 0.3 to 1.4 dB(A). GRA

N88-25458*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OVERVIEW OF NASA RESEARCH IN FIBER OPTICS FOR AIRCRAFT CONTROLS
Gary T. Seng 1988 9 p Proposed for presentation at the ISA/88 International Conference and Exhibit, Houston, Tex., 16-21 Oct. 1988; sponsored by the Instrument Society of America
(NASA-TM-100919; E-4156; NAS 1.15:100919) Avail: NTIS HC A02/MF A01 CSCL 01C

The challenge of those involved in aircraft control system hardware development is to accommodate an ever-increasing complexity in aircraft control, while limiting the size and weight of the components and improving system reliability. A technology that displays promise towards this end is fiber optics. The primary advantages of employing optical fibers, passive optical sensors and optically controlled actuators are weight/volume reduction, immunity from electromagnetic effects, high bandwidth capabilities and freedom from short circuits/sparking contacts. Since 1975, NASA Lewis has been performing in-house, contract and grant research in fiber optic sensors, high temperature electro-optic switches and fly-by-light control system architecture. Passive optical sensor development is an essential yet challenging area of work and has therefore received much attention during this period. A major effort to develop fly-by-light control system technology, known as the Fiber Optic Control System Integration (FOCSI) program, was initiated in 1985 as a cooperative effort between NASA and DOD. Phase 1 of FOCSI, completed in 1986, was aimed at the design of a fiber optic integrated propulsion/flight control system. Phase 2 will provide subcomponent and system development and system testing. In addition to a summary of the benefits of fiber optics, the FOCSI program, sensor advances, and future directions in the NASA Lewis program are discussed. Author

N88-25459*# Sverdrup Technology, Inc., Cleveland, Ohio.
TWO-DIMENSIONAL VISCOUS FLOW COMPUTATIONS OF HYPERSONIC SCRAMJET NOZZLE FLOWFIELDS AT DESIGN AND OFF-DESIGN CONDITIONS Final Report
G. J. Harloff, H. T. Lai, and E. S. Nelson Jun. 1988 18 p Presented at the 24th Joint Propulsion Conference, Boston, Mass., 11-13 Jul. 1988; sponsored in part by AIAA, ASME, SAE, and ASEE
(Contract NAS3-25266)
(NASA-CR-182150; E-4190; NAS 1.26:182150) Avail: NTIS HC A03/MF A01 CSCL 21E

The PARC2D code has been selected to analyze the flowfields of a representative hypersonic scramjet nozzle over a range of flight conditions from Mach 3 to 20. The flowfields, wall pressures, wall skin friction values, heat transfer values and overall nozzle performance are presented. Author

N88-25460*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
RECENT ADVANCES IN CAPACITANCE TYPE OF BLADE TIP CLEARANCE MEASUREMENTS
John P. Barranger [1988] 18 p Prepared for presentation at the Conference on Sensors and Measurement Techniques for Aeronautical Applications, Atlanta, Ga., 7-9 Sep. 1988; sponsored by AIAA
(NASA-TM-101291; E-4271; NAS 1.15:101291) Avail: NTIS HC A03/MF A01 CSCL 21E

Two recent electronic advances at NASA-Lewis that meet the blade tip clearance needs of a wide class of fans, compressors, and turbines are described. The first is a frequency modulated (FM) oscillator that requires only a single low cost ultrahigh frequency operational amplifier. Its carrier frequency is 42.8 MHz when used with a 61 cm long hermetically sealed coaxial cable. The oscillator can be calibrated in the static mode and has a negative peak frequency deviation of 400 kHz for a typical rotor blade. High temperature performance tests of the probe and 13 cm of the adjacent cable show good accuracy up to 600 C, the maximum which produces a clearance error of + or - 10 microns at a clearance of 500 microns. In the second advance, a guarded probe configuration allows a longer cable capacitance. The capacitance of the probe is part of a small time constant feedback in a high speed operational amplifier. The solution of the governing differential equation is applied to a ramp type of input. The results show an amplifier output that contains a term which is proportional to the derivative of the feedback capacitance. The capacitance is obtained by subtracting a balancing reference channel followed by an integration stage. Author

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N88-25461*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FLIGHT-MANAGEMENT STRATEGIES FOR ESCAPE FROM MICROBURST ENCOUNTERS M.S. Thesis - George Washington Univ.
David A. Hinton Aug. 1988 29 p
(NASA-TM-4057; L-16448; NAS 1.15:4057) Avail: NTIS HC A03/MF A01 CSCL 01C

An effort is underway by NASA, FAA, and industry to reduce the threat of convective microburst wind shear phenomena to aircraft. The goal is to develop and test a candidate set of strategies for recovery from inadvertent microburst encounters during takeoff. Candidate strategies were developed and evaluated using a fast-time simulation consisting of a simple point-mass performance model of a transport-category airplane and an analytical microburst model. The results indicate that the recovery strategy characteristics that best utilize available airplane energy include an initial reduction in pitch attitude to reduce the climb rate, followed by an increase in pitch up to the stick shaker angle of attack. The stick shaker angle of attack should be reached just as the airplane is exiting the microburst. The shallowest angle of climb necessary for obstacle clearance should be used. If the altitude is higher than necessary, an intentional descent to reduce the airspeed deceleration should be used. Of the strategies tested, two flight-path-angle based strategies had the highest recovery altitudes and the least sensitivity to variations in the encounter scenarios. Author

N88-25462*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
F-14 MODELING STUDY Final Report
William H. Levison Jul. 1988 54 p
(Contract NAS1-17648)
(NASA-CR-4164; NAS 1.26:4164; BBN-6579) Avail: NTIS HC A04/MF A01 CSCL 01C

This study explored application of a closed loop pilot/simulator model to the analysis of some simulator fidelity issues. The model was applied to two data bases: (1) a NASA ground based simulation of an air-to-air tracking task in which nonvisual cueing devices were explored, and (2) a ground based and inflight study performed by the Calspan Corporation to explore the effects of simulator delay on attitude tracking performance. The model predicted the major performance trends obtained in both studies. A combined analytical and experimental procedure for exploring simulator fidelity issues is outlined. Author

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N88-25463# Systems Control Technology, Inc., Arlington, Va. Program Engineering Service.
FOUR URBAN HELIPORT CASE STUDIES Final Report
Deborah Peisen and Jack Thompson Mar. 1988 57 p
(Contract DTFA01-87-C-00014)
(DOT/FAA/PM-87/32; DOT/FAA/PP-88/2; Rept-5542-6A3)
Avail: NTIS HC A04/MF A01

State and city governments generally realize that continued vitality depends on a steady expansion of industry and services as a function of planned growth. The helicopter is a proven catalyst for enhancement of those desired growth patterns. Case histories are developed for public use heliports built in the Central Business District of several major cities. Within each case history, common denominators are identified that are useful for planners in assessing the vitality of heliport proposals in cities that exhibit similar demographic characteristics. Each case study provides a general background as a setting and an inventory of pertinent heliport data: including location, cost, history, funding and revenue sources, operational characteristics, etc.; it addresses social concerns such as the local industrial base, neighboring land uses and zoning; and the public and governmental attitudes toward the heliport. Histories of four heliports are presented, specifically: the Bank-Whitmore Heliport (aka Nashua Street Heliport) in Boston, the Downtown Heliport in Indianapolis; the Downtown Heliport in New Orleans; and the Western and Southern Heliport in Cincinnati. Author

N88-25464*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TECHNIQUES UTILIZED IN THE SIMULATED ALTITUDE TESTING OF A 2D-CD VECTORING AND REVERSING NOZZLE
H. Bruce Block, Lively Bryant, John H. Dicus, Allan S. Moore, Maureen E. Burns, Robert F. Solomon, and Irving Sheer Jun. 1988 43 p
(NASA-TM-100872; E-4096; NAS 1.15:100872) Avail: NTIS HC A03/MF A01 CSCL 14B

Simulated altitude testing of a two-dimensional, convergent-divergent, thrust vectoring and reversing exhaust nozzle was accomplished. An important objective of this test was to develop test hardware and techniques to properly operate a vectoring and reversing nozzle within the confines of an altitude test facility. This report presents detailed information on the major test support systems utilized, the operational performance of the systems and the problems encountered, and test equipment improvements recommended for future tests. The most challenging support systems included the multi-axis thrust measurement system, vectored and reverse exhaust gas collection systems, and infrared temperature measurement systems used to evaluate and monitor the nozzle. The feasibility of testing a vectoring and reversing nozzle of this type in an altitude chamber was successfully demonstrated. Supporting systems performed as required. During reverser operation, engine exhaust gases were successfully captured and turned downstream. However, a small amount of exhaust gas spilled out the collector ducts' inlet openings when the reverser was opened more than 60 percent. The spillage did not affect engine or nozzle performance. The three infrared systems which viewed the nozzle through the exhaust collection system worked remarkably well considering the harsh environment. Author

N88-25465 Direction des Recherches, Etudes et Techniques, Gramat (France). Centre d'Etudes de Gramat.
TEST OF A PROTOTYPE GATE WITH FAST OPENING EQUIPPING THE SHOCK TUBE 0 2.40 m AT CEG
S. Gratias Mar. 1987 28 p In FRENCH
(PB87-227864; NT/T-87-15) Avail: NTIS HC E04/MF E04; copy not available at STI Facility CSCL 14B

In nuclear blast simulators, the generators are separated from the test section by diaphragms fitted with a pyrotechnical device. Since these diaphragms are not entirely satisfactory, they may be replaced by gates with fast opening. A prototype gate with 40 ms opening time was tested on the 2.40 m 0 shock tube. These tests showed that a shock wave with an overpressure less than 0.85 b could not be formed accurately except with opening times of much less than 40 ms. From the point of view of its mechanical concept, the principle of the gate seems satisfactory; thus, some improvements will be made on it towards obtaining opening times of less than 20 ms. Author

N88-25466*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
WIND TUNNEL WALL INTERFERENCE (JANUARY 1980 - MAY 1988): A SELECTED, ANNOTATED BIBLIOGRAPHY
Marie H. Tuttle (Vigyan Research Associates, Inc., Hampton, Va.) and Karen L. Cole Aug. 1988 88 p
(NASA-TM-4061; L-16465; NAS 1.15:4061) Avail: NTIS HC A05/MF A01 CSCL 14B

This selected bibliography lists 423 entries on the subject of wall interference during testing in wind tunnels. It is the third in a series of bibliographies on the subject. The first, NASA TM-87639, August 1986, is concerned with the reduction of wall interference by the use of adaptive walls. The second, NASA TP-89066, December 1986, is on wall interference in V/STOL and high lift testing. This, the third in the series, covers the wall interference literature published during the period January 1980 through May 1988, generally excluding those topics covered in the first two parts. Author

N88-26037# GKSS-Forschungszentrum Geesthacht (West Germany).
SAFETY ASPECTS IN DESIGN AND OPERATION PRACTICE OF GKSS UNDERWATER SIMULATION PLANT GUSI
Juergen Goedecken, L. Goehr, and Klaus Schmidt *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 155-159 (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N88-26031# Methodist Hospital, Indianapolis, Ind. Research and Development Dept.
THE US SPACE PROGRAMME
SPACEWALK/EXTRAVEHICULAR ACTIVITY EXPERIENCE: PAST, PRESENT AND FUTURE
Thomas P. Moore *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 115-120 (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N88-25467 Science Research Council, Chilton (England).
ATTITUDE AND ORBIT CONTROL FOR THE AMPTE-UKS (ACTIVE MAGNETOSPHERIC PARTICLE TRACER EXPLORES-UK SUBSATELLITE): EVALUATION OF THE IN-FLIGHT PERFORMANCE
L. P. Baldwin 1986 57 p
(PB87-225199; RAL-86-060) Avail: NTIS HC E04/MF E04; copy not available from STI Facility CSCL 22A

The Active Magnetospheric Particle Tracer Explorers (AMPTE)

program comprised a trio of satellite designed to orbit the Earth in formation to perform a series of experiments in the exploration of the Earth's magnetosphere. The satellites themselves were: the Charge Composition Explorer (CCE); the UK Subsatellite (UKS), and the Ion Release Module (IRM). They were built and operated by the USA, the UK, and the FRG, respectively. The contents include the following items: Boom deployment; Attitude maneuvers; Spin maneuvers; Orbit maneuvers; Initial conditions; Maneuver requests; Command data; and Final conditions. Author

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N88-25468# Los Alamos National Lab., N. Mex.
THE SRS (SEGMENTED RAIL SURFACE) RAILGUN: A NEW APPROACH TO RESTRIKE CONTROL
Jerald V. Parker 1988 7 p Presented at the 4th Symposium on Electromagnetic Launch Technology, Austin, Tex., 12 Apr. 1988
(Contract W-7405-eng-36)
(DE88-007907; LA-UR-88-709; CONF-880478-7) Avail: NTIS HC A02/MF A01

A Segmented Rail Surface (SRS) structure is described that eliminates restrike arcs by progressively disconnecting segments of the rail surface after the plasma armature has passed. This technique has been demonstrated using the Los Alamos MIDI-2 railgun. Restrike was eliminated in a plasma armature acceleration experiment using metal-foil fuses as opening switches. A plasma velocity increase from 11 to 16 km/s was demonstrated using the SRS technique to eliminate the viscous drag losses associated with the restrike plasma. This technique appears to be a practical option for a laboratory launcher at present and for future multi-shot launchers if appropriate switches can be developed. DOE

N88-25469# Lawrence Livermore National Lab., Calif.
STARFIRE: HYPERVELOCITY RAILGUN DEVELOPMENT FOR HIGH-PRESSURE RESEARCH
R. S. Hawke, A. R. Susoeff, J. R. Asay, J. K. Balk, C. A. Hall, C. H. Konrad, M. J. McDonald, K. W. Schuler, G. W. Wellman, and R. J. Hickman et al. 1 Mar. 1988 5 p Presented at the 4th Symposium on Electromagnetic Launch Technology, Austin, Tex., 12 Apr. 1988 Prepared in cooperation with Sandia National Labs., Albuquerque, N. Mex., Ktech Corp., Albuquerque, N. Mex., New Mexico Univ., Albuquerque and EG and G Energy Measurements, Inc., Albuquerque, N. Mex.
(Contract W-7405-eng-48)
(DE88-008348; UCRL-97384; CONF-880478-10) Avail: NTIS HC A02/MF A01

STARFIRE, a prog[illegible] based at Sandia National Laboratories, has as its goal the development of a hypervelocity railgun for use as a high-pressure research tool. The program has included efforts to identify and solve the problems that have inhibited reliable attainment of velocities greater than the 8 to 9 km/s attainable with two-stage light-gas guns (2SLGG). Issues studied include: plasma arc formation and stabilization, restrike inhibition, viscous drag, ratio of preload to operating stresses, barrel joint design, and barrel precision requirements. The system uses a 2SLGG as an injector to minimize barrel ablation and armature contamination. Hydrogen is used as the injection gas and will also serve to reduce the probability of forming secondary arcs. A VISAR optical Doppler system is used to continuously and precisely measure the projectile velocity from a standing start in the 2SLGG barrel, through several joints, the HELEOS (Hypervelocity Experimental Launcher for Equation of State) railgun barrel, and post-launch. The STARFIRE program is focused on the combined use of precision diagnostics and new experimental techniques. Results of tests are presented. DOE

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N88-25470*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
WEIGHT SAVINGS IN AEROSPACE VEHICLES THROUGH PROPELLANT SCAVENGING
Steven J. Schneider and Brian D. Reed 1988 25 p Presented at the 47th Annual Conference on Mass Properties Engineering, Plymouth, Mich., 23-25 May 1988; sponsored by the Society of Allied Weight Engineers, Inc.
(NASA-TM-100900; E-4079; NAS 1.15:100900; SAWE-1818)
Avail: NTIS HC A03/MF A01 CSCL 22B

Vehicle payload benefits of scavenging hydrogen and oxygen propellants are addressed. The approach used is to select a vehicle and a mission and then select a scavenging system for detailed weight analysis. The Shuttle 2 vehicle on a Space Station rendezvous mission was chosen for study. The propellant scavenging system scavenges liquid hydrogen and liquid oxygen from the launch propulsion tankage during orbital maneuvers and stores them in well insulated liquid accumulators for use in a cryogenic auxiliary propulsion system. The fraction of auxiliary propulsion propellant which may be scavenged for propulsive purposes is estimated to be 45.1 percent. The auxiliary propulsion subsystem dry mass, including the proposed scavenging system, an additional 20 percent for secondary structure, an additional 5 percent for electrical service, a 10 percent weight growth margin, and 15.4 percent propellant reserves and residuals is estimated to be 6331 kg. This study shows that the fraction of the on-orbit vehicle mass required by the auxiliary propulsion system of this Shuttle 2 vehicle using this technology is estimated to be 12.0 percent compared to 19.9 percent for a vehicle with an earth-storable bipropellant system. This results in a vehicle with the capability of delivering an additional 7820 kg to the Space Station. Author

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

No abstracts in this category.

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

No abstracts in this category.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N88-25471*# General Research Corp., McLean, Va. Aerospace Systems Group.
TECHNOLOGIES APPLICABLE TO SPACE TETHERS
William A. Baracat 1987 6 p
(Contract NASw-4138)
(NASA-CR-183055; NAS 1.26:183055) Avail: NTIS HC A02/MF A01 CSCL 22B

An investigation is presented of technologies which have been accumulated over the years, both on Earth and in space, dealing with tethers, ropes and cables. Many of these technologies can be applied, with modification, to both on-going and future space tether research and demonstration missions. The major areas of tether research and technology developments presented include multimegawatt power transmission, materials and structures, dynamics and control, environmental interactions, and in-space operations. These major topical areas are presented within the context of their associated research program or study. Author

N88-25472*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DESIGN GUIDELINES FOR ROBOTICALLY SERVICEABLE HARDWARE
Scott A. Gordon Apr. 1988 23 p
(NASA-TM-100700; NAS 1.15:100700) Avail: NTIS HC A03/MF A01 CSCL 13I

Research being conducted at the Goddard Space Flight Center into the development of guidelines for the design of robotically serviceable spaceflight hardware is described. A mock-up was built based on an existing spaceflight system demonstrating how these guidelines can be applied to actual hardware. The report examines the basic servicing philosophy being studied and how this philosophy is reflected in the formulation of design guidelines for robotic servicing. A description of the mock-up is presented with emphasis on the design features that make it robot friendly. Three robotic servicing schemes fulfilling the design guidelines were developed for the mock-up. These servicing schemes are examined as to how their implementation was affected by the constraints of the spacecraft system on which the mock-up is based. Author

N88-25473*# General Dynamics/Astronautics, San Diego, Calif. Space Systems Div.
CENTAUR OPERATIONS AT THE SPACE STATION Final Report, Sep. 1986 - Feb. 1987
J. Porter, W. Thompson, F. Bennett, and J. Holdridge 15 Feb. 1987 155 p
(Contract NAS3-24900)
(NASA-CR-179593; NAS 1.26:179593; GDSS-SP-87-003) Avail: NTIS HC A08/MF A01 CSCL 22B

A study was conducted on the feasibility of using a Centaur vehicle as a testbed to demonstrate critical OTV technologies at the Space Station. Two Technology Demonstration Missions (TDMs) were identified: (1) Accommodations, and (2) Operations. The Accommodations TDM contained: (1) berthing, (2) checkout, maintenance and safing, and (3) payload integration missions. The Operations TDM contained: (1) a cryogenic propellant resupply mission, and (2) Centaur deployment activities. A modified Space Station Co-Orbiting Platform (COP) was selected as the optimum refueling and launch node due to safety and operational considerations. After completion of the TDMs, the fueled Centaur would carry out a mission to actually test deployment and help offset TDM costs. From the Station, the Centaur could carry a single payload in excess of 20,000 pounds to geosynchronous orbit or multiple payloads. Author

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N88-26090# Joint Publications Research Service, Arlington, Va.
AUTOMATED SPECTROMETRIC UNIT FOR THE STUDY OF RADIATION CHARACTERISTICS OF COSMIC RADIATION ABOARD PROGNOZ-9 SPACE STATIONS
V. M. Petrov, Yu. I. Logachev, S. N. Karachevskiy, V. V. Bengin, I. K. Gvozdev, G. Ya. Kolesov, M. I. Kudryavtsev, A. I. Martynov, A. N. Podorolskiy, and S. A. Sud *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 107-111 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 75-78
(For primary document see N88-26069 19-51)
Copyright Avail: NTIS HC A08/MF A01

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N88-25474*# Minnesota Mining and Mfg. Co., St. Paul.
DESIGN AND DEMONSTRATION OF A SYSTEM FOR THE DEPOSITION OF ATOMIC-OXYGEN DURABLE COATINGS FOR REFLECTIVE SOLAR DYNAMIC POWER SYSTEM CONCENTRATORS Final Contractor Report
Donald J. McClure Jul. 1988 68 p
(Contract NAS3-25075)
(NASA-CR-4158; E-4150; NAS 1.26:4158) Avail: NTIS HC A04/MF A01 CSCL 22B

A system for the vacuum deposition of atomic-oxygen durable coatings for reflective solar dynamic power systems (SDPS) concentrators was designed and demonstrated. The design issues pertinent to SDPS were developed by the Government Aerospace Systems Division of the Harris Corporation and are described in NASA-CR-179489. Both design and demonstration phases have been completed. At the time of this report the deposition system was ready for coating of facets for SDPS concentrators. The materials issue relevant to the coating work were not entirely resolved. These issues can only be resolved when substrates which are comparable to those which will be used in flight hardware are available. The substrates available during the contract period were deficient in the areas of surface roughness and contamination. These issues are discussed more thoroughly in the body of the report. Author

N88-25475*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMAL DISTORTION ANALYSIS OF THE SPACE STATION SOLAR DYNAMIC CONCENTRATOR
Jeffrey J. Trudell, Vithal Dalsania, Joseph F. Baumeister (Analex Corp., Cleveland, Ohio.), and Kent S. Jefferies 1988 25 p
Presented at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. - 5 Aug. 1988; sponsored by ASME, AIAA, SAE, ANS, IEEE, ASC and AIChE
(NASA-TM-100868; E-4090; NAS 1.15:100868) Avail: NTIS HC A03/MF A01 CSCL 10B

A method was developed to evaluate the thermal distortion of the Space Station Solar Dynamic Concentrator and the effects of thermal distortion on concentrator optical performance. The

analytical method includes generating temperature distributions with TRASYS and SINDA models, interfacing the SINDA results with the SINDA-NASTRAN Interface Program (SNIP), calculating thermal distortion with a NASTRAN/PATRAN finite element model, and providing flux distribution maps within the receiver with the ray tracing OFFSET program. Temperature distributions, thermally induced slope errors, and flux distribution maps within the receiver are discussed. Results during a typical orbit indicate that temperatures of the hexagonal panels and triangular facets range between -18 and 99 C (-1 to 210 F), facet rotations are less than 0.2 mrad, and a change in facet radius due to thermal flattening is less than 5 percent. The predicted power loss with thermal distortion effects was less than 0.3 percent. The thermal distortion of the Solar Dynamic concentrator has negligible effect on the flux distribution within the receiver cavity. Author

N88-25476*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPONENT IMPROVEMENT OF FREE-PISTON STIRLING ENGINE KEY TECHNOLOGY FOR SPACE POWER
Donald L. Alger [1988] 13 p Prepared for presentation at the 4th International Conference on Stirling Engines, Tokyo, Japan, 7-10 Nov. 1988; sponsored by Japan Society of Mechanical Engineers
(NASA-TM-100950; E-4243; NAS 1.15:100950) Avail: NTIS HC A03/MF A01 CSCL 10B

The successful performance of the 25 kW Space Power Demonstrator (SPD) engine during an extensive testing period has provided a baseline of free piston Stirling engine technology from which future space Stirling engines may evolve. Much of the success of the engine was due to the initial careful selection of engine materials, fabrication and joining processes, and inspection procedures. Resolution of the few SPD engine problem areas that did occur has resulted in the technological advancement of certain key free piston Stirling engine components. Derivation of two half-SPD, single piston engines from the axially opposed piston SPD engine, designated as Space Power Research (SPR) engines, has made possible the continued improvement of these engine components. The two SPR engines serve as test bed engines for testing of engine components. Some important fabrication and joining processes are reviewed. Also, some component deficiencies that were discovered during SPD engine testing are described and approaches that were taken to correct these deficiencies are discussed. Potential component design modifications, based upon the SPD and SPR engine testing, are also reported. Author

N88-25477*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MOVING BELT RADIATOR DEVELOPMENT STATUS
K. Alan White Jul. 1988 24 p Presented at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. - 5 Aug. 1988; sponsored in part by ASME, AIAA, ANS, SAE, IEEE, ACS and AIChE
(NASA-TM-100909; E-4140; NAS 1.15:100909) Avail: NTIS HC A03/MF A01 CSCL 22A

Development of the Moving Belt Radiator (MBR) as an advanced space radiator concept is discussed. The ralative merits of Solid Belt (SBR), Liquid Belt (LBR), and Hybrid Belt (HBR) Radiators are described. Analytical and experimental efforts related to the dynamics of a rotating belt in microgravity are reviewed. The development of methods for transferring heat to the moving belt is discussed, and the results from several experimental investigations are summarized. Limited efforts related to the belt deployment and stowage, and to fabrication of a hybrid belt, are also discussed. Life limiting factors such as seal wear and micrometeroid resistance are identified. The results from various MBR point design studies for several power levels are compared with advanced Heat Pipe Radiator technology. MBR designs are shown to compare favorable at both 300 and 1000 K temperature levels. However, additional effort will be required to resolve critical technology issues and to demonstrate the advantage of MBR systems. Author

N88-25566# United Technologies Corp., San Jose, Calif. Chemical Systems Div.
CHARACTERISTIC TIME CORRELATIONS TO LIQUID FUEL RAMJET COMBUSTION EFFICIENCY
K. E. Gallagher, G. F. Sander, and D. F. Brink *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 127-137 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21H

N88-25571# California Univ., Berkeley. Dept. of Mechanical Engineering.
LOW FREQUENCY PRESSURE OSCILLATIONS IN A MODEL RAMJET COMBUSTOR
K. Yu, A. Trouve, and John W. Daily *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 193-198 (For primary document see N88-25554 19-28)
(Contract N00014-84-K-0372)
Avail: NTIS HC A17/MF A01 CSCL 19A

N88-25572# San Diego State Univ., Calif.
THE PRESSURE FIELD GENERATED IN A COLD-FLOW SIDE-DUMP RAMJET COMBUSTOR
Gregory Hildebrand and Nagy Nosseir *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 199-208 (For primary document see N88-25554 19-28)
(Contract N00014-84-K-0373)
Avail: NTIS HC A17/MF A01 CSCL 21H

N88-25573# Department of the Navy, Washington, D. C. Lab. for Computational Physics and Fluid Dynamics.
EFFECTS OF MACH NUMBER ON ACOUSTIC-VORTEX INTERACTIONS IN A RAMJET
K. Kailasanath, J. H. Gardner, J. P. Boris, and E. S. Oran *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 209-218 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21H

N88-25574# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
CONTROL OF COMBUSTION INSTABILITIES IN RAMJET MOTORS
U. G. Hegde, D. M. Reuter, B. R. Daniel, and B. T. Zinn *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 219-228 (For primary document see N88-25554 19-28)
(Contract N00014-84-K-0470)
Avail: NTIS HC A17/MF A01 CSCL 21H

N88-25575# Naval Postgraduate School, Monterey, Calif.
IGNITION AND FLAMMABILITY CHARACTERISTICS OF SOLID FUEL RAMJETS
R. C. Wooldridge, A. Karadimitris, and D. W. Netzer *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 229-238 (For primary document see N88-25554 19-28)
(Proj. N6053087WR30009)
Avail: NTIS HC A17/MF A01 CSCL 21H

N88-25576*# Aerojet TechSystems Co., Sacramento, Calif.
DEVELOPMENT OF A GENERIC COMBUSTION STABILITY CODE FOR LIQUID PROPELLANT ROCKET ENGINES
J. J. Fang and Y. T. Jones *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 239-257 (For primary document see N88-25554 19-28)
(Contract NAS8-36274)
Avail: NTIS HC A17/MF A01 CSCL 21H

N88-25577*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NUMERICAL GRID GENERATION AND FLOW SIMULATION IN SSME THRUST CHAMBER
K. W. Gross, P. L. Daley, and A. J. Przekwas (CHAM of North

America, Inc., Huntsville, Ala.) *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 259-266 (For primary document see N88-25554 19-28)
(Contract NAS8-36552)
Avail: NTIS HC A17/MF A01 CSCL 21H

N88-25580*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A DETAILED DESCRIPTION OF THE UNCERTAINTY ANALYSIS FOR HIGH AREA RATIO ROCKET NOZZLE TESTS AT THE NASA LEWIS RESEARCH CENTER
Kenneth J. Davidian, Ronald H. Dieck (Pratt and Whitney Aircraft, West Palm Beach, Fla.), and Isaac Chuang *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 291-318 Previously announced as N87-28602 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21H

N88-25581*# Software and Engineering Associates, Inc., Carson City, Nev.
A COMPUTER PROGRAM FOR PERFORMANCE PREDICTION OF TRIPROPELLANT ROCKET ENGINES WITH TANGENTIAL SLOT INJECTION
Anthony Dang and Gary R. Nickerson *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 319-327 (For primary document see N88-25554 19-28)
(Contract NAS8-36863)
Avail: NTIS HC A17/MF A01 CSCL 19A

N88-25584*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LIQUID ENGINE JET ATOMIZATION WORKSHOP REPORT
Klaus W. Gross *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 351-353 Workshop held in Huntsville, Ala., 16-17 Sep. 1987 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21H

N88-25593# Naval Research Lab., Washington, D.C. Lab. for Computational Physics and Fluid Dynamics.
NUMERICAL INVESTIGATION OF ACOUSTIC ENERGY EXCHANGE THROUGH FLOW TURNING
Joseph D. Baum *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 79-100 (For primary document see N88-25585 19-28)
(Contract MIPR-87-0040)
Avail: NTIS HC A19/MF A01 CSCL 21H

N88-25594# Naval Weapons Center, China Lake, Calif. Research Dept.
MOTOR TEST DATA COMPARISONS WITH LABORATORY DATA AND STABILITY PREDICTIONS
J. E. Crump, H. B. Mathes, W. H. Clark, and M. W. Beckstead (Brigham Young Univ., Provo, Utah.) *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 101-114 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 21H

N88-25595# Atlantic Research Corp., Alexandria, Va.
ONE PERSON'S VIEW OF VELOCITY-COUPLED INSTABILITY
Merrill K. King *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 115-130 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 21H

N88-25596# Air Force Astronautics Lab., Edwards AFB, Calif.
VELOCITY COUPLING
Gary L. Vogt *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 131-139 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 21H

N88-25607# Morton Thiokol, Brigham City, Utah. Advanced Technology Div.
SOLID ROCKET MOTOR PERFORMANCE: A WORKSHOP REPORT
Mark Salita *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 253-276 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 21H

N88-25618# Morton Thiokol, Brigham City, Utah. Space Operations.
A MULTIPLE CHAMBER VOLUME-FILLING MODEL FOR PREDICTION OF TRANSIENT SOLID ROCKET MOTOR BALLISTIC PERFORMANCE
James Henderson *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 393-402 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 21H

N88-25646# National Aerospace Lab., Kakuda (Japan).
ANALYSIS OF FLOW THROUGH PUMP OF LARGE ROCKET ENGINE
Hitoshi Yamada and Yoshiaki Watanabe *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 115-119 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

23 CHEMISTRY AND MATERIALS (GENERAL)

N88-25478*# California Univ., San Diego, La Jolla.
DETERMINATION OF LOW MOLECULAR WEIGHT THIOLS USING MONOBROMOBIMANE FLUORESCENT LABELING AND HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY
Robert C. Fahey and Gerald L. Newton [1988] 19 p
(Grant NAGw-342)
(NASA-CR-182932; NAS 1.26:182932) Avail: NTIS HC A03/MF A01 CSCL 07A

Methods are described for the preparation and high-performance liquid chromatography (HPLC) analysis of monobromobimane derivatives of low molecular weight thiols in extracts of biological samples. Typical problems encountered in the development and application of these methods are discussed. Analysis of mung bean extract is used as an example. J.P.B.

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials*.

N88-25479*# Los Alamos National Lab., N. Mex. Tritium Science and Technology Group.
SOLID-STATE COMBUSTION SYNTHESIS OF CERAMICS AND ALLOYS IN REDUCED GRAVITY Final Report
S. M. Valone and R. G. Behrens Jul. 1988 85 p
(NASA Order C-80011-F)
(NASA-CR-4163; E-4086; NAS 1.26:4163) Avail: NTIS HC A05/MF A01 CSCL 21B

Possible microgravity effects are explored in the combustion synthesis of ceramics and alloys from their constituent elements. Molten intermediates are typically present during the combustion process, thereby offering the chance for natural convection to take place. Numerical simulations suggest that the combustion front in concert with gravity may act as a partial zone-refinement mechanism which is attempting to sweep out porosity in the sample. Contrary to suggestions by dimensional analysis, no effects on

the combustion rate are seen. An analytical model of the combustion velocity as a function of the gravitational field and the spreading rate of molten material gives the correct order of magnitude of the gravity effect as measured by centrifuge experiments. Author

N88-25480*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PROPERTIES OF TWO COMPOSITE MATERIALS MADE OF TOUGHENED EPOXY RESIN AND HIGH-STRAIN GRAPHITE FIBER
Marvin B. Dow and Donald L. Smith (PRC Kentron, Inc., Hampton, Va.) Jul. 1988 44 p
(NASA-TP-2826; L-16425; NAS 1.60:2826) Avail: NTIS HC A03/MF A01 CSCL 11D

Results are presented from an experimental evaluation of IM7/8551-7 and IM6/18081, two new toughened epoxy resin, high strain graphite fiber composite materials. Data include ply-level strengths and moduli, notched tension and compression strengths and compression-after-impact assessments. The measured properties are compared with those of other graphite-epoxy materials. Author

N88-25481# Massachusetts Inst. of Tech., Cambridge.
ELECTRONIC AND STRUCTURAL STUDIES OF CARBON/CARBON COMPOSITES Report, 1 Sep. 1986 - 31 Aug. 1987
G. L. Doll, R. M. Sakya, J. T. Nicholls, J. S. Speck, and M.S. Dresselhaus 30 Oct. 1987 7 p Prepared in cooperation with Nuclear Aerospace Materials Corp., Poway, Calif.
(Contract F49629-85-C-0147)
(AD-A191729; AFOSR-88-0227TR) Avail: NTIS HC A02/MF A01 CSCL 11D

Room temperature Raman microprobe x-ray diffraction and electrical resistivity measurements have been performed on carbon/carbon composites made from mesophase pitch which were heat treated at temperatures above 2680 Celsius. Results of these measurements indicate that both the ex-pitch carbon fiber and mesophase pitch matrix constituents of the composites were highly graphitic, exhibiting in-plane crystallite dimensions greater than 1000 Angstroms. The c-axis crystallite dimensions were determined by analysis of x ray diffraction peak widths to be approximately 150 Angstroms. Copper chloride was successfully reacted with these carbon-carbon composites forming a stage three graphite intercalation compound in both the fibers and the matrix, as determined by their Raman spectra. GRA

N88-25482# Texas A&M Univ., College Station. Mechanics and Materials Center.
FRACTURE PHYSICS OF DELAMINATION OF COMPOSITE MATERIALS Final Technical Report, 1 Feb. 1984 - 30 Jun. 1987
W. L. Bradley, C. R. Corleto, and D. P. Goetz Oct. 1987 267 p
(Grant AF AFOSR-0064-84)
(AD-A192021; MM-5021-87-12; AFOSR-88-0020TR) Avail: NTIS HC A12/MF A01 CSCL 11D

Real time observations in the scanning electron microscope have delineated the details of the fracture processes that result in mode 1 and mode 2 delamination of composite materials. These in situ observations of fracture indicate that distinctively different damage zone develops ahead of growing cracks for mode 1 and mode 2 delamination. Two techniques have been developed to measure the strain field around a crack tip. Both are effective in measuring the strain field around a crack tip. A surprising result which emerged from these measurements is that the local strain to failure at the crack tip is much greater than the elongation measured in a tensile test (up to six times as high). A linear, orthotropic finite element code has been used to calculate the stress fields around the crack tip for mode 1 and mode 2 loading. A J-integral approach for mode 1 has been used to investigate the delamination of multi directional composites. Initial results using this approach look very promising for characterizing systems which can not be characterized with conventional analysis. GRA

N88-25483*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A THERMALLY MODIFIED POLYMER MATRIX COMPOSITE MATERIAL WITH STRUCTURAL INTEGRITY TO 371 C
Kenneth J. Bowles 1988 12 p Proposed for presentation at the 20th International SAMPE Technical Conference, Minneapolis, Minn., 27-29 Sep. 1988; sponsored by the Society for Advancement of Material and Processing Engineering
(NASA-TM-100922; E-4182; NAS 1.15:100922) Avail: NTIS HC A03/MF A01 CSCL 11D

The potential for utilizing surface coatings to inhibit the thermal oxidation of polymer matrix composites was studied. Isothermal, inert gas exposures of graphite/PMR-15 composites indicated that after an initial loss of weight, no significant amounts of thermal degradation products are given off during high temperature exposures in the absence of oxygen. As long as a coating remains effective, the composite material should remain stable. It was also found that the glass transition temperature T sub g of the matrix resin could be increased to values in excess of 400 C. This resulted in measured short beam shear strengths of 75.9 MPa (11 Ksi), flexural strengths of 1172 MPa (170 Ksi) and flexural moduli of 141 GPa (20.5 Msi) for the material at a test temperature of 371 C. The treatment that was used caused a decrease in the PMR-15 resin density from 1.31 to 1.29 gm/cc. It was concluded that state-of-the-art composites, protected by oxygen-impervious coatings, can be used as materials of construction with structural integrity to at least 371 C and possibly above. Author

N88-25484*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Technical Center for Composite Materials and Structures.
TEMPERATURE-DEPENDENT TENSILE AND SHEAR RESPONSE OF GRAPHITE/ALUMINUM
T. Fujita, M. J. Pindera, and C. T. Herakovich May 1987 139 p Sponsored by NASA, Goddard Space Flight Center, Greenbelt, Md. and Materials Sciences Corp., Spring House, Pa.
(NASA-CR-182914; NAS 1.26:182914; PB88-181037; VPI-E-87-8; CCMS-87/08) Avail: NTIS HC A07/MF A01 CSCL 11D

The thermo-mechanical response of unidirectional P100 graphite fiber/6061 aluminum matrix composites was investigated at four temperatures:-150, +75, +250, and +500 F. Two types of tests, off-axis tension and losipescu shear, were used to obtain the desired properties. Good experimental-theoretical correlation was obtained for Exx, vxy, and G12. It is shown that E11 is temperature independent, but E22, v12, and G12 generally decrease with increasing temperature. Compared with rather high longitudinal strength, very low transverse strength was obtained for the graphite/aluminum. The poor transverse strength is believed to be due to the low interfacial bond strength in this material. The strength decrease significantly with increasing temperature. The tensile response at various temperatures is greatly affected by the residual stresses caused by the mismatch in the coefficients of thermal expansion of fibers and matrix. The degradation of the aluminum matrix properties at higher temperatures has a deleterious effect on composite properties. The composite has a very low coefficient of thermal expansion in the fiber direction. GRA

N88-25485# Fermi National Accelerator Lab., Batavia, Ill.
INVESTIGATION OF LEAKS IN FIBERGLASS-REINFORCED PRESSURE VESSELS BY DIRECT OBSERVATION OF HOLLOW FIBERS IN GLASS CLOTH
J. McAdams Jan. 1988 7 p
(Contract DE-AC02-76CH-03000)
(DE88-006936; FNAL-TM-1511) Avail: NTIS HC A02/MF A01

A simple method of visual observation of hollow fibers within fiberglass cloth has been developed. This visualization can aid in determining the contribution these fibers make toward leaks observed in fiberglass-reinforced epoxy resin pressure or vacuum vessels. Photographs and frequency data of these hollow fibers are provided. DOE

N88-25486# Cornell Univ., Ithaca, N.Y. Dept. of Materials Science and Engineering.
STRONG FIBERS Progress Report, 15 Jul. 1987 - 14 Jul. 1988
H. H. Johnson Mar. 1988 12 p
(Contract DE-FG02-87ER-45321)
(DE88-007798; DOE/ER-45321/1) Avail: NTIS HC A03/MF A01

The proposal submitted a year ago described an innovative program to use microfabrication technology to produce fibers of metals, ceramics, and intermetallic compounds with interesting mechanical and physical properties. The approach was to integrate advanced deposition processes such as reactive evaporation, coevaporation, and sputtering with patterns generated by optical lithography to produce fibers with transverse dimensions in the micrometer range, and lengths from much less than a millimeter to several centimeters. This technology can also be used to produce two-dimensional grids and particulates of different sizes and geometries. This experimental approach allows an unprecedented control of dimensions, geometry, composition, and structure. The initial materials foci of the proposed program were alumina (Al203) and the mixed metal oxides of alumina with metal solutes, and intermetallic compounds such as the nickel and titanium aluminides. DOE

N88-25487*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AUGER ANALYSIS OF A FIBER/MATRIX INTERFACE IN A CERAMIC MATRIX COMPOSITE
Frank S. Honecy (Case Western Reserve Univ., Cleveland, Ohio.) and Stephen V. Pepper 1988 10 p Presented at the Spring Meeting of the Materials Research Society, Reno, Nev., 4-9 Apr. 1988
(NASA-TM-100892; E-4130; NAS 1.15:100892) Avail: NTIS HC A02/MF A01 CSCL 11D

Auger electron spectroscopy (AES) depth profiling was used to characterize the fiber/matrix interface of an SiC fiber, reaction bonded Si3N4 matrix composite. Depth profiles of the as received double coated fiber revealed concentration oscillations which disappeared after annealing the fiber in the environment used to fabricate the composite. After the composite was fractured, the Auger depth profiles showed that failure occurred in neither the Beta-SiC fiber body nor in the Si3N4 matrix but, concurrently, at the fiber coating/matrix interface and within the fiber coating itself. Author

N88-25488# Los Alamos National Lab., N. Mex.
MICROLAMINATE COMPOSITE STRUCTURES BY LOW PRESSURE PLASMA SPRAY DEPOSITION
R. G. Castro and P. W. Stanek 1988 12 p Presented at the International Powder Metallurgy Conference and Exhibition, Orlando, Fla., 5 Jun. 1988
(Contract W-7405-eng-36)
(DE88-006453; LA-UR-88-589; CONF-880667-1) Avail: NTIS HC A03/MF A01

The low pressure plasma spray (LPPS) process has been utilized in the development and fabrication of metal/metal, metal/carbide, and metal/oxide composite structures; including particulate dispersion and both continuous and discontinuous laminates. This report describes the LPPS process and the development of copper/tungsten microlaminate structures utilizing this processing method. Microstructures and mechanical properties of the Cu/W composites are compared to conventionally produced constituent material properties. DOE

N88-25489*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
FATIGUE TESTING AND DAMAGE DEVELOPMENT IN CONTINUOUS FIBER REINFORCED METAL MATRIX COMPOSITES
W. S. Johnson Jun. 1988 55 p
(NASA-TM-100628; NAS 1.15:100628) Avail: NTIS HC A04/MF A01 CSCL 11D

A general overview of the fatigue behavior of metal matrix composites (MMC) is presented. The first objective is to present experimental procedures and techniques for conducting a meaningful fatigue test to detect and quantify fatigue damage in MMC. These techniques include interpretation of stress-strain responses, acid etching of the matrix, edge replicas of the specimen under load, radiography, and micrographs of the failure surfaces. In addition, the paper will show how stiffness loss in continuous fiber reinforced metal matrix composites can be a useful parameter for detecting fatigue damage initiation and accumulation. Second, numerous examples of how fatigue damage can initiate and grow in various MMC are given. Depending on the relative fatigue behavior of the fiber and matrix, and the interface properties, the failure modes of MMC can be grouped into four categories: (1) matrix dominated, (2) fiber dominated, (3) self-similar damage growth, and (4) fiber/matrix interfacial failures. These four types of damage will be discussed and illustrated by examples with the emphasis on the fatigue of unnotched laminates. Author

N88-25490*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LOADING RATE SENSITIVITY OF OPEN HOLE COMPOSITES IN COMPRESSION
Steve J. Lubowinski, E. G. Guynn, Wolf Elber (Army Aerostructures Directorate, Hampton, Va.), and J. D. Whitcomb Jun. 1988 34 p
(NASA-TM-100634; NAS 1.15:100634; AVSCOM-TM-88-B-012)
Avail: NTIS HC A03/MF A01 CSCL 11D

The results are reported of an experimental study on the compressive, time-dependent behavior of graphite fiber reinforced polymer composite laminates with open holes. The effect of loading rate on compressive strength was determined for six material systems ranging from brittle epoxies to thermoplastics at both 75 F and 220 F. Specimens were loaded to failure using different loading rates. The slope of the strength versus elapsed time-to-failure curve was used to rank the materials' loading rate sensitivity. All of the materials had greater strength at 75 F than at 220 F. All the materials showed loading rate effects in the form of reduced failure strength for longer elapsed-time-to-failure. Loading rate sensitivity was less at 220 F than the same material at 70 F. However, C12000/ULTEM and IM7/8551-7 were more sensitive to loading rate than the other materials at 220 F. AS4/APC2 laminates with 24, 32, and 48 plies and 1/16 and 1/4 inch diameter holes were tested. The sensitivity to loading rate was less for either increasing number of plies or larger hole size. The failure of the specimens made from brittle resins was accompanied by extensive delaminations while the failure of the roughened systems was predominantly by shear crippling. Fewer delamination failures were observed at the higher temperature. Author

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N88-25491# Texas Univ. at Dallas, Richardson.
QUANTITATIVE USE OF EXCIPLEX-BASED VAPOR/LIQUID VISUALIZATION SYSTEMS, USERS' MANUAL Final Report, 1 Jul. 1986 - 31 Oct. 1987
Lynn A. Melton 14 Jan. 1988 75 p
(Grant DAAL03-86-K-0082)
(AD-A191649; ARO-24068.2-EG) Avail: NTIS HC A04/MF A01 CSCL 21B

This report is written in the form of a users manual for exciplex-based vapor/liquid visualization systems. It attempts to bring together in one handbook all the photophysical functions and parameters specific to the exciplex system which will be needed by a user who is otherwise skilled with planar laser induced fluorescence. In addition, it attempts to identify the major

assumptions required for the derivations, to define the experimental conditions under which near quantitative interpretation of the fluorescence is possible, and to recommend protocols for visualization experiments. The best visualization systems developed so far are based on the exciplex formed between N, N, N', N'-tetramethy-p-phenylenediamine (TMPD) and Napthalene or 1-Methylnapthtalene. For these systems, when used with n-tetradecane as the solvent (fuel), it should be possible to measure the liquid and vapor mass concentrations in a volume element of + or - 25 percent, provided that oxygen is excluded. The functions and parameters given in this manual are those appropriate for these two systems. GRA

N88-25492*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
AN IMPROVED EXTERNAL RECYCLE REACTOR FOR DETERMINING GAS-SOLID REACTION KINETICS
Irvin M. Miller and Ronald F. Hoyt [1987] 7 p Submitted for publication
(NASA-TM-101160; NAS 1.15:101160) Avail: NTIS HC A02/MF A01 CSCL 07D

These improvements in the recycle system effectively eliminate initial concentration variation by two modifications: (1) a vacuum line connection to the recycle loop which permits this loop to be evacuated and then filled with the test gas mixture to slightly above atmospheric pressure; and (2) a bypass line across the reactor which permits the reactor to be held under vacuum while the rest of the recycle loop is filled with test gas. A three-step procedure for bringing the feed gas mixture into contact with the catalyst at time zero is described. J.P.B.

N88-25493# California Univ., Berkeley. Lawrence Berkeley Lab.
ELECTRODE FILMS OF POROUS AGAROSE: THE EFFECTS OF PHYSICAL STRUCTURE ON ELECTRON TRANSPORT PROCESSES Ph.D. Thesis
Kelly D. Moran Feb. 1988 162 p
(Contract DE-AC03-76SF-00098)
(DE88-007366; LBL-24822) Avail: NTIS HC A08/MF A01

Potential use of chemically modified electrodes in electrocatalysis has stimulated interest in creation and characterization of electrode films for reagent immobilization. We have created two highly porous electrocatalyst support matrices, with high rates of electron transport, both based on immobilization of reagents in agarose gel. In one case, Nafion was impregnated into agarose gel films. Diffusion of methyl viologen in Nafionagarose matrices are higher than in Nafion. In Nafion, the diffusion coefficient decreases with increasing methyl viologen concentration, while in Nafionagarose, the opposite dependence is observed. The faster rate of electron transport in Nafionagarose films is related to the heterogeneous structure and the coupling of the diffusion pathways. In the second application of agarose gels as an electrode coating material, agarose hydroxyl groups were activated in 1,1'carbonyldiimidazole and subsequently reacted with amine derivatives of electroactive mediators. Electron transport between the electroactive sites in the gel is very rapid (on the order of 10 to the -7 cm/sec).Interpreting the data in light of the Dahms-Ruff description of electron transport shows that the rate of electron transport through both ferrocene and viologen derivatized gels is limited by the rate of electron self-exchange of the species. DOE

N88-25494# Georgia Univ., Athens. Dept. of Chemistry.
FUNDAMENTAL STUDIES OF SEPARATION PROCESSES
L. B. Rogers 1988 13 p
(Contract DE-AS09-76ER-00854)
(DE88-007487; DOE/ER-00854/44) Avail: NTIS HC A03/MF A01

This report deals primarily with chromatographic studies, many of them concerned with factors which are improtant in separations of isomeric species, and some exploring effects of using different solvent sand different column packings. Concurrent NMR studies showed that some chemical shifts could be correlated with the relative orders of elutions of enantiomers and with energies of interactions calculated using Allinger's molecular mechanics program, MM2. In addition, two feasibility studies have been done. The first used a computer-controlled linear pH gradient by mixng a strong acid and strong base to fractionate a mixture of weak organic acids. The second demonstrated the advantage of using 1 mm glass beads as a column support in recycle gas chromatography. Finally, two papers dealt with the long-standing problem of discrepancies found in quantitative trace determinations obtained when different laboratories analyze differnt portions of the same sample. DOE

N88-25495# Emory Univ., Atlanta, Ga. Dept. of Chemistry.
THEORETICAL STUDIES OF DYNAMICS COMBUSTION Progress Report
J. M. Bowman 1988 25 p
(Contract DE-FG05-86ER-13568)
(DE88-007565; DOE/ER-13568/T1) Avail: NTIS HC A03/MF A01

Progress has been made in several areas of gas-phase collision dynamics of relevance to combustion processes. The new initiative in recombination dynamics has led to a detailed quantum and quasiclassical characterization of the long-lived resonance states of HCO. In addition, work has begun on high energy H + CO scattering, which is providing additional insight into the interaction dynamics. Work has continued on reduced dimensionality approaches to three-dimensional reactive scattering, and the latest comparison with accurate quantum calculations continues to demonstrate the accuracy of the approach. A formal study of energy transfer extending the quantum forced-oscillator model was completed, and this work may find future use in the study of energy transfer from highly excited polyatomic molecules, and may even bear on stabilization dynamics in recombination. DOE

N88-25496*# National Aeronautics and Space Administration, Washington, D.C.
MASS SPECTROMETRIC HIGH TEMPERATURE MEASUREMENTS OF THE BARIUM OXIDE-ZIRCONIUM DIOXIDE SYSTEM AND THE DETERMINATION OF THERMODYNAMIC DATA FOR BARIUM ZIRCONATE. CLARIFICATION OF THE COUNTER-STOPPING CAPACITY OF COATED PARTICLES FOR SOLID FISSION PRODUCTS BY ZIRCONIUM DIOXIDE ADDITION
R. Odoj and K. Hilpert Jun. 1988 121 p Transl. into ENGLISH of Massenspektrometrische Hochtemperatur Messung des Systems BaO-ZrO2 und Bestimmung Thermodynamischer Daten des BaZrO3. Ein Beitrag zur Klaerung des Rueckhaltevermoegens Beschichteter...Oct. 1975 p 1-101 Transl. by SCITRAN, Inc., Santa Barbara, Calif. Original document was prepared by Juelich Nuclear Research Station
(Contract NASw-4307)
(NASA-TT-20187; NAS 1.77:20187) Avail: NTIS HC A06/MF A01 CSCL 07D

Retention of fission products in reaction processes of fission products and mass spectrometric high temperature measurements with a Knudsen cell, general part, are discussed. Calculation of thermodynamic quantities from the measurements to determine the reaction enthalpy according to the Second Law of Thermodynamics, calculation of the reaction enthalpy from the third Law of Thermodynamics and calculation of the specific heat and entropy of BaZrO3 from BaTiO3 are presented. Author

N88-25497*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
DEVELOPMENT OF A COMPUTERIZED ANALYSIS FOR SOLID PROPELLANT COMBUSTION INSTABILITY WITH TURBULENCE Semiannual Report
T. J. Chung and O. Y. Park May 1988 49 p
(Grant NAG8-627)
(NASA-CR-182351; NAS 1.26:182351) Avail: NTIS HC A03/MF A01 CSCL 21B

A multi-dimensional numerical model has been developed for the unsteady state oscillatory combustion of solid propellants

subject to acoustic pressure disturbances. Including the gas phase unsteady effects, the assumption of uniform pressure across the flame zone, which has been conventionally used, is relaxed so that a higher frequency response in the long flame of a double-base propellant can be calculated. The formulation is based on a premixed, laminar flame with a one-step overall chemical reaction and the Arrhenius law of decomposition with no condensed phase reaction. In a given geometry, the Galerkin finite element solution shows the strong resonance and damping effect at the lower frequencies, similar to the result of Denison and Baum. Extended studies deal with the higher frequency region where the pressure varies in the flame thickness. The nonlinear system behavior is investigated by carrying out the second order expansion in wave amplitude when the acoustic pressure oscillations are finite in amplitude. Offset in the burning rate shows a negative sign in the whole frequency region considered, and it verifies the experimental results of Price. Finally, the velocity coupling in the two-dimensional model is discussed. Author

N88-25498# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
COAL PARTICLE BEHAVIOUR IN A COUNTER-CURRENT COMBUSTOR
N. Libbis, Z. Hazanov, Y. Goldman, J. B. Greenberg, and Y. M. Timnat Jan. 1987 40 p Sponsored in part by KFA, Julich (Federal Republic of Germany), and from the Ministry of Energy and Infrastructure
(TAE-606) Avail: NTIS HC A03/MF A01

The gas-phase using the two equation turbulence model, which is solved for a domain corresponding to the experimental conditions, using a uniformly-spaced grid and appropriate boundary conditions is presented. Theoretical distributions of axial and radial velocity, and axial pressure and temperature are shown. The experimental procedure is then treated in detail, presenting the combustor employed and discussing the determination of gas velocity, temperature and concentration, with particular attention to the instruments used and the effects of turbulence and misalignment. The experimental results covering measurements performed with a cyclone section showed that combustion has a strong influence on the velocity distribution, narrowing considerably the radial component and accentuating the effect of the reverse flow. The temperature starts to rise fast after 20 cm and reaches a maximum of 1420 K after 30 cm for low flow rate, arriving at 1700 K at 35 cm for high flow rate. These measurements, together with the axial and radial distribution of the permanent components point to a fast turbulent reaction, with a sizeable cooling effect caused by the entrance of air downstream. Author

N88-25499 Selskapet for Industriell og Teknisk Forskning, Trondheim (Norway).
TURBULENCE AND FLAME PROPAGATION
M. Brostroem, S. Byggstoeyl, B. Grimsmo, J. Holen, and N. I. Lilleheie Jan. 1987 66 p
(PB87-228912; STF15-A87003; ISBN-82-595-4532-2) Avail: NTIS HC E04/MF E04; copy not available from STI Facility CSCL 13B

Five subreports which all together represents the authors section's recent research in turbulence and flame propagation is presented. Part 1 contains calculations of a turbulent nitrogen diffusion flame based on Eddy Dissipation Concept (EDC), which is the basic idea in the authors turbulent combustion research. Part 2 is concerned with measurements and calculations of lift-off and blow-off of turbulent diffusion flames. Part 3 gives a view of what the authors section has developed of flow and combustion models in an Otto motor. Part 4 describes how extinction can be achieved by water injection. Part 5 consists of combustion development in pool fires. Author

N88-25500*# National Aeronautics and Space Administration, Washington, D.C.
FLAME SPREAD MECHANISMS OVER PMMA SURFACES
Toshisuke Hirano, T. Koshida, and K. Akita Jul. 1988 19 p Transl. into ENGLISH of Japanese Association of Fire Science and Engineering (Japan), v. 27, no. 2, 1977 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20284; NAS 1.77:20284) Avail: NTIS HC A03/MF A01 CSCL 21B

The mechanisms by which flames spread over flat surfaces of polymethylmethacrylate (PMMA) were studied. Spread rates of vertically downward and horizontally spreading flames were measured, and the gas velocity and temperature profiles near the spreading flames were examined using particle tracer techniques, fine wire thermocouples, and a Mach-Zender interferometer. For PMMA sheets thinner than 0.2 cm, the spread rate was inversely proportional to the thickness, and for those thicker than 2.0 cm, it was independent of the thickness. The velocity profiles in front of the preheat zone resembled those across the boundary layer near a uniform temperature wall, while those in the preheat zone and pyrolysis zone resembled those across the boundary layer with a diffusion flame. The temperature profiles indicated that the heat flux to the surface increased with the decrease of the distance from the pyrolysis front. A brief theoretical analysis based on the experimental results indicated that when a burning sheet was thin, the heat flux through the gas phase into the solid phase in the preheat zone was much larger than that into the solid phase in the pyrolysis zone, while when a burning sheet was thick, this relation between the heat fluxes became reversed. Author

N88-25501*# National Aeronautics and Space Administration, Washington, D.C.
EFFECT OF THICKNESS ON DOWNWARD FLAME SPREAD OVER PAPER
Toshisuke Hirano and Koichi Tazawa Jun. 1988 17 p Transl. into ENGLISH from Japanese Association of Fire Science and Engineering (Japan), v. 26, no. 1, 1976 p 7-13 Transl. by SCITRAN, Inc., Santa Barbara, Calif. Original document was prepared by Ibaraki Univ., Hitachi (Japan)
(Contract NASw-4307)
(NASA-TT-20282; NAS 1.77:20282) Avail: NTIS HC A03/MF A01 CSCL 21B

An experimental study has been conducted to explore the effect of thickness on downward flame spread over thin solid-fuel sheets in an upward air stream. Flame spread rates over paper of four different thicknesses at various air-stream velocities were measured, and the gas velocity and temperature profiles in the vicinity of spreading flames were examined using particle tracer techniques and fine-wire thermocouples. It was confirmed that the spread rate of a stably spreading flame decreased with the increase of the thickness. The gas velocity profile in the vicinity of the leading edge of the preheat zone and the gas temperature profile in the preheat zone were almost independent of the paper thickness. In the case of stable flame spread, the mass burning rate decreased with the increase of the air-stream velocity and increased with the increase in thickness. The increase of the mass burning rate with the paper thickness was confirmed to be partly due to the heat transfer to the unburned material through solid phase, and mainly due to the existence of the solid-phase temperature difference in the direction normal to the paper surface. Author

N88-25502*# National Aeronautics and Space Administration, Washington, D.C.
MEASUREMENT OF THE RADIATIVE PROPERTIES OF GAS AND OIL FLAMES
H. Tietze and R. Guenther Jun. 1988 24 p Transl. into ENGLISH from Messung der Strahlungseigenschaften von Gas- und Oelflammen, Gas Waerme International (Federal Republic of Germany), v. 25, no. 1-12, Nov. - Dec. 1976 p 563-570 Transl. by SCITRAN, Inc., Santa Barbara, Calif. Original document was performed by Karlsruhe Univ., Fed. Republic of Germany Sponsored by Arbeitsgemeinschaft Industrieller Forschungsvereinigungen e.V. and Forschungsgemeinschaft...
(Contract NASw-4307)
(NASA-TT-20299; NAS 1.77:20299) Avail: NTIS HC A03/MF A01 CSCL 07D

Radiation and concentration measurements were carried out with different flame lengths in order to predict the interaction between furnace and flame in respect of heat emission with combustion spaces of varying dimensions. Fuel, heat throughput, burner momentum, air ratio and, in some cases, the momentum of the atomizing air were varied. Evaluation of the instrument readings will furnish information about the local distribution of the degree of emission and temperature under different input conditions and give an idea of the variations to be expected when changing over from a small combustion space to a larger one. The paper deals mainly with the radiation and temperature measuring methods used and presents a description of the test setup. The results obtained are outlined. Author

N88-25503*# National Aeronautics and Space Administration, Washington, D.C.
KINETICS OF HOMOGENEOUS NUCLEATION IN SUPERHEATED F-11 AND F-21 LIQUID FREONS
V. N. Chukanov and V. P. Skripov May 1988 12 p Transl. into ENGLISH from Izucheniye Kinetiki Gomogennogo Zarodysheobrazovaniya v Peregretykh Zhidkikh Freonakh F-11, F-21, Tr. Ural. Politekh. Inst. (USSR), no. 189, 1971 p 48-54 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20286; NAS 1.77:20286) Avail: NTIS HC A03/MF A01 CSCL 07D

An experimental verification was carried out for the kinetic theory of homogeneous nucleation in superheated liquids using F-11 and F-21 freons. The experimental data are in good agreement with theory. The reason for this lies in the fact that theory properly gives the work of formation of the critical nuclei which is a definite factor in nucleation. The surface tension at high temperatures is calculated from the experimental data with an accuracy better than 1 percent. Author

N88-25504# Sandia National Labs., Albuquerque, N. Mex.
KINETICS OF CO OXIDATION OVER A DEACTIVATED Rh(111) SINGLE CRYSTAL CATALYST
C. H. F. Peden, P. J. Berlowitz, and D. W. Goodman 1988 17 p Presented at the 9th International Catalysis Congress, Calgary, Alberta, 26 Jun. 1988
(Contract DE-AC04-76DP-00789)
(DE88-003000; SAND-87-1288C; CONF-880602-3) Avail: NTIS HC A03/MF A01

Kinetic measurements of the CO oxidation reaction over a model Rh(111) single crystal catalyst, made under highly oxidizing conditions (O2CO2 ratios greater than 301), are reported. Catalytic activity is reduced, but not eliminated, under these conditions as the near-surface region becomes oxidized (probably to Rh2O3). However, the reaction occurs by a different mechanism andor involves a different rate-determining step as evidenced by the altered kinetics (activation energy and pressure dependencies) compared to the clean surface under reducing conditions. Post-reaction temperature programmed desorption spectra revealed a new CO2 feature at temperatures above that required for CO2 or CO desorption from the clean surface. The presence of this feature and the measured kinetics under oxidizing conditions suggest that the mechanism involves the rate-limited decomposition of a carbonate-like species strongly bound to the oxidized Rh surface. The results further show that the oxide nucleates in islands, giving rise to an intermediate regime in which reaction occurs by the above mechanism on the oxide islands, and by the normal process on the open patches of clean Rh, simultaneously. DOE

N88-25505# Colorado State Univ., Fort Collins. Dept. of Physics.
PROSPECTS FOR LARGE DYNAMIC RANGE ISOTOPE ANALYSIS USING PHOTON BURST MASS SPECTROMETRY
W. M. Fairbank, Jr., R. D. LaBelle, R. A. Keller, C. M. Miller, J. Poths, and B. L. Fearey 1988 4 p Presented at the 4th International Symposium on Resonance Ionization Spectroscopy and its Applications, Gaithersburg, Md., 10 Apr. 1988 Prepared in cooperation with Los Alamos National Lab., N. Mex.
(Contract W-7405-eng-36)
(DE88-009110; LA-UR-88-1407; CONF-880435-15) Avail: NTIS HC A02/MF A01

Photon Burst Mass Spectrometry is a relatively new and untried method which may complement and extend the impressive achievements of Resonance Ionization Mass Spectrometry and Accelerator Mass Spectrometry in the field of large dynamic range isotope analysis. Theoretical predictions indicate that measurements in the 10(sup -11) to 10(sup -15) range are possible in a reasonable period of time with zero background. Experimentally only the very first demonstrations of PBMS with stable isotopes have been completed. DOE

N88-25506# Los Alamos National Lab., N. Mex.
HIGH-FIDELITY IN ISOTOPE RATIO MEASUREMENTS FOR RESONANCE IONIZATION MASS SPECTROMETRY
C. M. Miller, B. L. Fearey, B. A. Palmer, and N. S. Nogar 1988 5 p Presented at the 4th International Symposium on Resonance Ionization Spectroscopy and its Applications, Gaithersburg, Md., 10 Apr. 1988
(Contract W-7405-eng-36)
(DE88-009129; LA-UR-88-1251; CONF-880435-11) Avail: NTIS HC A02/MF A01

Calculations are performed to gauge the effect of the convolution of atomic spectral characteristics with laser sources upon isotope ratio measurements by Resonance Ionization Mass Spectrometry (RIMS). Comparison with experimental data is included. DOE

N88-25507# Pacific Northwest Labs., Richland, Wash.
ALTERNATE TECHNIQUES FOR NOBLE-GAS DETECTION
T. J. Whitaker and B. D. Cannon Apr. 1988 5 p Presented at the 4th International Symposium on Resonance Ionization Spectroscopy and its Applications, Gaithersburg, Md., 10 Apr. 1988
(Contract DE-AC06-76RL-01830)
(DE88-009471; PNL-SA-15397; CONF-880435-18) Avail: NTIS HC A02/MF A01

Two new noble-gas analysis techniques that do not use resonance ionization are described. One method is isotopically selective and uses photon burst measurements; the other is a nonselective fluorescence technique. Both methods make use of the 1s sub 5 metastable state in noble gases. A comparison is made between these methods and resonance ionization spectroscopy techniques. DOE

N88-25508# Argonne National Lab., Ill.
ELECTRONIC STRUCTURE OF ZINTL PHASE COMPOUNDS BY NONLINEAR OPTIMIZATION
C. Woodward, R. Benedek, and B. I. Min Mar. 1988 12 p Presented at the Sanibel Symposium on Atomic, Molecular and Condensed Matter Theory, Gainesville, Fla., 12 Mar. 1988
(Contract W-31-109-eng-38)
(DE88-009998; CONF-8803104-1) Avail: NTIS HC A03/MF A01

Since the introduction of dynamical simulated annealing (DSA) by Car and Parrinello in 1985, there has been growing interest in the use of nonlinear optimization to perform electronic structure calculations. We review here the complementary method of steepest descents (SD), a first-order treatment designed for local optimization. Modifications are discussed to adapt SD to a supercell treatment of metallic systems using a plane wave basis. An application to the Zintl phase compound NaTl is presented. The application of separable nonlocal pseudopotentials to improve this momentum space formalism is discussed. DOE

N88-25509# Fermi National Accelerator Lab., Batavia, Ill.
THERMOPHYSICAL PROPERTIES OF ARGON
A. Jaques Feb. 1988 201 p
(Contract DE-AC02-76CH-03000)
(DE88-010376; FNAL-TM-1517) Avail: NTIS HC A10/MF A01

The entire report consists of tables of thermodynamic properties

(including sound velocity, thermal conductivity and diffusivity, Prandtl number, density) of argon at 86 to 400 K, in the form of isobars over 0.9 to 100 bars. DOE

N88-25510# California Univ., Berkeley. Lawrence Berkeley Lab.
XUV SOURCE FOR ULTRA-HIGH RESOLUTION PHOTOIONIZATION SPECTROSCOPY
E. Cromwell, A. H. Kung, T. Trickl, and Y. T. Lee Jan. 1988 11 p Presented at SPIE O-E Lase '88: Optoelectronics and Laser Applications in Science and Engineering, Los Angeles, Calif., 10 Jan. 1988
(Contract DE-AC02-76CH-00016)
(DE88-007531; LBL-24636; CONF-880110-27) Avail: NTIS HC A03/MF A01

A tunable VUV-XUV laser system with good pulse energy (greater than 100 mJ in the visible) and narrow bandwidth (less than 210 MHz in the XUV) was built in order to do ultra-high resolution photoionization spectroscopy. The capabilities of this system have been demonstrated with a study of isotope shifts and hyperfine splitting in Kr Rydberg levels. DOE

N88-25511# Brigham Young Univ., Provo, Utah. Dept. of Chemistry.
SUPERCRITICAL FLUID CHROMATOGRAPHY/SUPERSONIC JET SPECTROSCOPY Progress Report, 1 Dec. 1987 - 29 Feb. 1988
S. R. Goates and M. L. Lee 1988 10 p
(Contract DE-FG22-86PC-90534)
(DE88-007935; DOE/PC-90534/9) Avail: NTIS HC A02/MF A01

Work has included exploration of the characteristics of the high-pressure sheath flow nozzle for use with supersonic jet spectroscopy, preliminary testing of the direct-expansion pulsed nozzle, packed-column supercritical fluid chromatography experiments with direct-expansion supersonic jet fluorescence spectroscopy, and continued development of the pulsed, low-pressure sheath-flow nozzle and of a fully degenerate four-wave mixing detection scheme. We have obtained very good spectra of perylene with the high pressure sheath-flow nozzle. The entire nozzle asembly was heated by a thermal coaxial heater wrapped around the nozzle body, and the heating effect was further enhanced by putting a small copper tube along the tip of the column restrictor. Examination of the temperature gradient by the method described in our last report helped us to properly configure the heater, and now we are constructing a more practical (less jury-rigged) heater. DOE

N88-25512# Oak Ridge National Lab., Tenn.
AN EVALUATION OF SOME THERMODYNAMIC AND TRANSPORT PROPERTIES OF SOLID AND LIQUID LITHIUM OVER THE TEMPERATURE RANGE 200 TO 1700 K
R. K. Williams, G. L. Coleman, and D. W. Yarbrough Mar. 1988 32 p
(Contract DE-AC05-84OR-21400)
(DE88-008947; ORNL/TM-10622) Avail: NTIS HC A03/MF A01

Experimental data on the effects of temperature on the density, thermal expansion coefficient, specific heat, enthalpy, vapor pressure, compressibility, surface tension, viscosity, electrical resistivity and thermal conductivity of lithium were reviewed. Comparisons of original data with handbook values revealed some cases in which the latter values should probably be revised. Empirical equations describing the recommended property values are included. DOE

N88-25513# Westinghouse Hanford Co., Richland, Wash.
IRREVERSIBLE DISSOLUTION OF SOLID SOLUTIONS: A KINETIC AND STOICHIOMETRIC MODEL
W. M. Murphy and R. W. Smith Sep. 1987 19 p Presented at the International Conference on Chemistry and Migration Behavior of Actinides and Fission Products in the Geosphere, Munich, Fed. Republic of Germany, 14 Sep. 1987
(Contract DE-AC06-87RL-10930)
(DE88-009194; WHC-SA-0090-FP; CONF-870965-6) Avail: NTIS HC A03/MF A01

A model for the kinetics and stoichiometry of irreversible dissolution of solid solutions is developed mathematically for an ideal binary system. The principal assumptions in the model are that the forward (dissolution) reaction is stoichiometric and zero order, that the reverse (growth) reaction stoichiometry corresponds to the solid that is most stable with respect to the aqueous solution (greatest affinity to precipitate), and that the surface composition is homogeneous but variable in time. The model is applied to analogs of spent nuclear fuel with the compositions U(sub 0.99)Pu(sub 0.01)O2 and U(IV)(sub 0.99)U(VI)(sub 0.01)O(sub 2.01). Numerical computations of mass release in a closed system indicate that in the first example, the aqueous solution comes to equilibrium with a PuO2 enriched surface. In the second example, the solution achieves equilibrium with a surface that is depleted in U(VI). DOE

N88-25514# New Mexico Univ., Albuquerque. Engineering Research Inst.
NEXT-GENERATION FIRE EXTINGUISHING AGENT. PHASE 1: SUPPRESSION CONCEPTS Interim Report, Aug. 1985 - Aug. 1986
Robert E. Tapscott and E. T. Morehouse, Jr. Jul. 1987 49 p
(Contract F29601-84-C-0080)
(AD-A192279; NMERI-WA3-31-(3.21); AFESC/ESL-TR-87-03)
Avail: NTIS HC A03/MF A01 CSCL 13L

This report documents Phase 1 of an effort to develop concepts for new and more effective fire extinguishing agents. In Phase 1 a technology review was performed, suppression hypotheses were developed, and a Phase 2 plan was established. The technology review covers fire physics, chemistry, and engineering information relevant to flame structure, fire modeling, combustion reactions, oxidation kinetics, and fire suppression. The Phase 2 effort will emphasize halon like agents owing to their cleanliness and ability to suppress three-dimensional fires. GRA

N88-25555# Sandia National Labs., Albuquerque, N. Mex. Combustion Research Facility.
THE COMBUSTION OF HYDROXYLAMMONIUM NITRATE BASED LIQUID PROPELLANTS
Steven R. Vosen *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 1-9 Sponsored by DOE, Washington, D.C. and the Department of the Army, Washington, D.C. (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21B

N88-25556# Sandia National Labs., Albuquerque, N. Mex. Combustion Research Facility.
A DYNAMIC MODEL OF LIQUID PROPELLANT COMBUSTION
Robert Armstrong and Steven R. Vosen *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 11-18 Sponsored by DOE, Washington, D.C. and the Department of the Army, Washington, D.C. (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21B

N88-25567*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMBUSTION RATE LIMITS OF HYDROGEN PLUS HYDROCARBON FUEL: AIR DIFFUSION FLAMES FROM AN OPPOSED JET BURNER TECHNIQUE
Gerald L. Pellett, Rosemary Guerra, Lloyd G. Wilson, Ronald N. Reeves, and G. Burton Northam *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 139-153 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21B

N88-25568*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MACH 2 COMBUSTION CHARACTERISTICS OF HYDROGEN/HYDROCARBON FUEL MIXTURES

Glenn S. Diskin, C. J. Jachimowski, G. Burton Northam, and Randy A. Bell (George Washington Univ., Hampton, Va.) *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 155-169 Previously announced in IAA as A88-20321 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21B

N88-25570# M L Energia, Inc., Princeton, N.J.
RECENT ADVANCES IN PHOTOCHEMICAL TECHNIQUES FOR IGNITION AND COMBUSTION ENHANCEMENT
Moshe Lavid and Arthur T. Poulos *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 179-192 (For primary document see N88-25554 19-28)
(Contract F49620-85-C-0145; Grant NSF ISI-85-21264)
Avail: NTIS HC A17/MF A01 CSCL 19A

N88-25578# Illinois Univ., Chicago. Dept. of Mechanical Engineering.
ANATOMY OF GROUP BURNING MODE TRANSITIONS IN SPRAY GROUP COMBUSTION
S. A. Lottes and H. H. Chiu *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 267-276 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21B

N88-25604# Air Force Astronautics Lab., Edwards AFB, Calif.
ANALYSIS OF MICROWAVE BURNER MEASUREMENT SYSTEM USING A MICROWAVE NETWORK ANALYSIS COMPUTER PROGRAM
Gary L. Vogt *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 217-233 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 21B

N88-25605# Air Force Astronautics Lab., Edwards AFB, Calif.
MODELING AND EXPERIMENTAL MEASUREMENTS OF SOLID PROPELLANT FLAME STRUCTURE
T. Edwards *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 235-242 Sponsored by AFOSR, Bolling AFB, Washington, D.C. (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 21B

N88-25613# Colorado Univ., Boulder. Dept. of Mechanical Engineering.
STRUCTURE OF LAMINAR, PREMIXED FLAMES OF CH2O/NO2/O2 MIXTURES
M. C. Branch and M. Sadeqi *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 343-351 (For primary document see N88-25585 19-28)
(Grants AF-AFOSR-0006-84; NSF INT-86-04371)
Avail: NTIS HC A19/MF A01 CSCL 21B

N88-25614# IIT Research Inst., Chicago, Ill.
LASER-RDX AEROSOL PYROLYSIS WITH MATRIX ISOLATION OF UNSTABLE INTERMEDIATES
A. Snelson *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 353-358 (For primary document see N88-25585 19-28)
(Contract DAAG29-85-K-0143)
Avail: NTIS HC A19/MF A01 CSCL 21B

N88-25615# Sandia National Labs., Albuquerque, N. Mex. Combustion Research Facility.
THEORETICAL STUDIES OF THE CHEMICAL REACTIONS INVOLVED IN THE IGNITION OF NITRAMINES
Carl F. Melius *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 359-366 Sponsored in part by the Department of the Army, Washington, D.C. and DOE, Washington, D.C. (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 21B

N88-25623# Joint Publications Research Service, Arlington, Va.
BASIC RESEARCH IN SUPERSONIC COMBUSTION
In its JPRS Report: Science and Technology. Japan 4 May 1988 p 48-51 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jan. 1988 p 2-4 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

N88-25647# Iwaki Meisei Univ. (Japan).
NUMERICAL SIMULATION OF IGNITION OF HYDROGEN JET IN HOT AIR
Fumio Takayama, Shirou Taki, Toshitaka Fujiwara, Koichi Hayashi, and Akira Sakurai (Tokyo Denki Univ., Japan) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 121-127 In JAPANESE; ENGLISH summary Previously announced in IAA as A87-33954 (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N88-25515# Oak Ridge National Lab., Tenn.
THE POSTIRRADIATION TENSILE PROPERTIES AND MICROSTRUCTURE OF SEVERAL VANADIUM ALLOYS
D. N. Braski 1988 39 p Presented at the 14th International Symposium on Effects of Radiation on Materials, Andover, Mass., 27 Jun. 1988
(Contract DE-AC05-84OR-21400)
(DE88-007140; CONF-880613-1) Avail: NTIS HC A03/MF A01

Tensile specimens of V-15Cr-5Ti, Vanstar-7, V-3Ti-1si, and V-20Ti were irradiated at 420 degrees C t420 degrees C to a damage level of 82d to levels up to 480 appm in selected specimens using a modified tritium trick. Irradiation hardening was the dominant effect influencing the postirradiation tensile properties, and it markedly increased the yield strength and reduced the total elogation. The V-15Cr-5Ti alloy was very sensitive to helium embrittlement, but Vanstar-7 and V-3Ti-1Si were only slightly affected. Without helium, negligible swelling (less than 1%) were measured in V-3Ti-1Si and V-20Ti. Preimplanted helium increased swelling in V-3Ti-1Si by increasing cavity nucleation. DOE

N88-25516# Ames Lab., Iowa.
NONDESTRUCTIVE EVALUATION METHODS FOR DETERMINATION OF THERMAL HISTORY AND MECHANICAL PROPERTIES OF ALUMINUM-LITHIUM ALLOYS Ph.D. Thesis
D. J. Bracci Nov. 1987 107 p
(Contract W-7405-eng-82)
(DE88-007352; IS-T-1316) Avail: NTIS HC A06/MF A01

A binary Al-8 at% Li and a commercial Al 2090 alloy have been quenched from the solid solution phase at two different quench rates. Subsequent artificial aging treatments between 150 and 275 C, with aging times ranging from 3 to 33 hours, were chosen to arrive at alloys of different microstructures and mechanical properties. Nondestructive measurements of eddy current impedance change, dc conductivity, microhardness, ultrasonic attenuation, and ultrasonic velocity have been performed. Eddy vary by roughly 5 to 10%. Hardness changes are about two-fold for Al 2090 and about three-fold for the binary alloy. Ultrasonic attenuation and velocity are basically independent of heat treatment. Yield stresses changed by a factor of 4 to 5 and the fracture toughness estimates changed by about 60% for the binary alloy. Yield stress for the Al 2090 changed by about a factor of 3.5. Correlations have been made between the results obtained from the nondestructive measurements and the mechanical properties of the materials. Eddy current impedance change is linearly proportional to hardness except for the Al 2090 alloy aged for 12 hours and longer. Hardness is a strong indicator of yield stress due to their linear relationship. For the binary alloy,

there is an asymptotic relationship between hardness and fracture toughness estimates. DOE

N88-25517# Titanium Metals Corp. of America, Henderson, Nev.
OPTIMIZATION OF MECHANICAL/CORROSION PROPERTIES OF TI-CODE 12 PLATE AND SHEET. PART 2: THERMOMECHANICAL PROCESSING EFFECTS
R. W. Schultz and J. A. Hall Jan. 1988 114 p
(Contract DE-AC04-76DP-00789)
(DE88-007493; SAND-87-7171-Pt-2) Avail: NTIS HC A06/MF A01

In an effort to determine and subsequently optimize mechanical and corrosion properties of the TI-CODE 12 alloy for a container application, a two-stage study was conducted. Stage 1 was directed toward evaluation of the effect of compositional variations, within ASTM specification limits, on specific mechanical and corrosion properties of TI-CODE 12. Compositional variables investigated were weight percent molybdenum, nickel, oxygen, and iron. Compositional ranges of TI-CODE 12 were identified which correspond to select combinations of desirable properties. Stage 2 program objectives include evaluation of five distinct thermomechanical processes with respect to TI-CODE 12 0.25 inch (6.35mm) plate and 0.070 inch (1.78mm) sheet corrosion and mechanical propreties, with subsequent selection of a process route which achieves optimum properties. In addition to addressing effects of intermediate recrystallization and cross-rolling steps for reduction of property directionality, the influence of final product anneal is examined. In particular, the influence of a conventional mill anneal at 1450°F (788°C) is compared to that of the sub-eutectoid 1250°F (677°C) annual. DOE

N88-25518*# National Aeronautics and Space Administration, Washington, D.C.
EFFECT OF Zr OR Cr CONTENT ON THE FRACTURE TOUGHNESS OF THE HIGH PURITY Al-Zn-Mg ALLOYS
Eiji Kato, Yoshisada Ueda, and Hideshi Mori Jul. 1988 17 p Transl. into ENGLISH from Japan Institute of Light Metals, Journal (Japan), v. 36, Dec. 1986 p 791-798 Original language document was announced in IAA as A87-35601 Transl. by SCITRAN, Inc., Santa Barbara, Calif. Original document prepared by Nagoya Univ., Japan
(Contract NASw-4307)
(NASA-TT-20294; NAS 1.77:20294) Avail: NTIS HC A03/MF A01 CSCL 11F

The effects of Zr and Cr additions on the microstructure, fracture toughness, tensile properties, and ductility of Al-Zn-Mg alloys are investigated. The data reveal that the grain size decreases and the fracture toughness increases as the Zr content increases; a fracture toughness maximum is detected when the Zr content is 0.18 percent; and for Zr additions greater than 0.18 percent, the distributive density of the eta-prime phase becomes lower when the large dispersoids appear in the matrix and the fracture toughness decreases. For the Cr additions, it is observed that the tensile strength decreases with increasing Cr additions and the fracture toughness increases up to 0.32 percent. It is determined that Zr additions have a significant effect on tensile strength and Cr content affects the absorbed energy. Author

N88-25519*# National Aeronautics and Space Administration, Washington, D.C.
MARTENSITIC TRANSFORMATION AND MICROSTRUCTURES IN SINTERED NiAl ALLOYS
Shouichi Ochiai, Nanabu Ueno, and Samu Noguchi Jun. 1988 22 p Transl. into ENGLISH from Japan Inst. of Metals Journal (Japan), v. 51, Jul. 1987 p 686-693 Original language document was announced in IAA as A88-10603 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20192; NAS 1.77:20192; ISSN-0021-4876) Avail: NTIS HC A03/MF A01 CSCL 11F

The characteristics of martensitic transformation and microstructures in sintered NiAl alloys manufactured by hot-pressed powder metallurgy were investigated. When presintering was followed by hot pressing in vacuum, alloys having a relative density higher than 99 percent of theoretical values were obtained. Sintered NiAl specimens quenched from 1573 K in ice brine had a complete martensitic structure. An increase in density of about 1 percent and a decrease in hardness of about 5 percent were observed in quenched specimens compared with prequenched ones. Both results can be explained equalitatively in terms of crystal structure change. All sintered NiAl aloys exhibited a good shape memory effect. The reverse transformation temperature decreased sharply with increasing Al content, with a slope of about 160 K at. percent Al. When the sintered specimens with martensite structure were bent with large deformation at room temperature, they tended to fail by cleavage fracture. Author

N88-25520# Los Alamos National Lab., N. Mex.
INFLUENCE OF STRAIN RATE ON THE SUBSTRUCTURE EVOLUTION AND YIELD BEHAVIOR OF Ti-6Al-4V
G. T. Gray, III and P. S. Follansbee 1988 9 p Presented at the 6th World Conference on Titanium, Cannes, Frances, 6 Jun. 1988
(Contract W-7405-eng-36)
(DE88-006457; LA-UR-88-604; CONF-880681-2) Avail: NTIS HC A02/MF A01

Based upon a study of the influence of strain rate on the substructure evolution and mechanical response of Ti-Al6-4V the following conclusions can be drawn: (1) The deformation substructure of Ti-6-4 is observed to depend on both temperature and strain rate. Deformation at quasi-static strain rates at 293K is characterized by planar slip bands in the alpha grains while the deformation substructure at high strain rates (e.g., 5000 s(sup -1) and at quasi-static rates at 77K consists of numerous deformation twins, (1121) type believed to be related to the starting texture and strain rate effects. (2) The constitutive equations based on the Kocks/Mecking model have been successfully applied to predict the deformation response of Ti-6-4 to loading path changes involving a relatively narrow regime in strain rate and temperature. Changes in slip character or in deformation mechanism (e.g., deformation twinning) have been observed to correlate with changes in the expected flow behavior, although these results are beyond the current modeling procedures outlined in this paper. DOE

N88-25521# Sandia National Labs., Albuquerque, N. Mex.
ELECTRODEPOSITION OF AMORPHOUS Ni-Cr-P ALLOYS
T. R. Guilinger and J. E. Voytko 1988 7 p Presented at the AESF SUR/FIN 88 Exposition, Los Angeles, Calif., 27 Jun. 1988
(Contract DE-AC04-76DP-00789)
(DE88-006868; SAND-87-2573C; CONF-880684-1) Avail: NTIS HC A02/MF A01

We developed a plating bath to deposit adherent, pore-free, amorphous Ni-Cr-P alloys which exhibit excellent corrosion resistance. The bath consists of the chlorides of chromium and nickel with hypophosphite ion or a mixture of phosphorous and phosphoric acids as the phosphorus source. We used citrate ion as complexing agent to shift the Ni deposition potential to more cathodic values so that Ni and Cr codeposition could occur. Potentiodynamic corrosion testing of amorphous deposits with at least 10 at. percent Cr showed corrosion resistance in pitting acid chloride environments superior to such engineering alloys as 304 stainless steel and Hastelloy C-276. DOE

N88-25522# Concordia Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
EXTENDED DUCTILITY OF Al AND ALPHA-Fe ALLOYS THROUGH DYNAMIC RECOVERY MECHANISMS
H. J. McQueen and M. E. Kassner 22 Mar. 1988 20 p Presented at the TMS-AIME/ASM Symposium on High Temperature Mechanical Properties of Ordered Intermetallics, Phoenix, Ariz., 25 Jan. 1988 Prepared in cooperation with Lawrence Livermore National Lab., Calif.
(Contract W-7405-eng-48)

(DE88-008679; UCRL-98487; CONF-880126-3) Avail: NTIS HC A03/MF A01

Materials exhibiting extended ductility do not have tensile ducitility greater than 2, i.e., 650 percent, an m greater than 0.4, a fine grain size and grain boundary sliding as a principal mechanism. Torsional ductility in Al or Al-2Mg attains strains of 136 or 82.5 associated with m approx. 0.2 and coarse grains within which a recovered substructure forms. Similarly, in alpha-Fe and Fe- 25Cr, failure is delayed to strains of 100 to 600. Coarse-grained Al alloys based on solid solution, e.g., Al- 5Mg, exhibit tensile ductilities up to 300 percent as a result of m approx. 0.35 due to solute drag with n = 3. High ductility in Al stems from dynamic recovery permitting grain flow to accommodate grain boundary sliding and prevent fissure formation. The formation of large subgrains is accompanied by local grain boundary migration into serrations which also limit sliding and cracking. The Al- 5Mg has good tensile ductility compared to Al but has very low torsional ductility because of its reduced rate of dynamic recovery. The above behavior is contrasted with the thermomechanical processing and properties of superplastic Al alloys. DOE

N88-25523# Stanford Univ., Calif. Dept. of Materials Science and Engineering.

DEVELOPMENT OF FINE-GRAINED CARBIDE-PARTICLE HARDENED HADFIELD MANGANESE STEELS Final Report

T. Oyama, A. Goldberg, and O. D. Sherby 1 Sep. 1987 42 p Prepared in cooperation with Lawrence Livermore National Lab., Calif.

(Contract W-7405-eng-48)

(DE88-008919; UCRL-21036) Avail: NTIS HC A03/MF A01

Three Hadfield Manganese (HM) steels containing different carbon concentrations (1.2, 1.4 and 1.7 percent C) were hot-and-warm worked (HWW). The microstructures developed consist of relatively fine austenite grains (less than 10 microns) with spheroidized carbides. The hot-and-warm worked HM steels were then tested in torsion at intermediate and high temperatures (500 to 950 C). Ductility, flow stress, stress-strain relations, and microstructural changes were analyzed as a function of temperature, strain rate, and carbon concentration. The principal factors affecting the torsional ductility of the HM steels were the flow stress during deformation, the temperature, and the carbon content. At intermediate flow stresses, the expected trend of ductility decrease with an increase in flow stress was observed. At low stresses, and high temperatures, however, the ductility was lower than expected due to decarburization. At high stresses, and low temperatures, the ductility was higher than expected due to strain-enhanced transformation to pearlite-spheroidite structures. DOE

N88-25524# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

LOW-CHROMIUM REDUCED-ACTIVATION FERRITIC STEELS

R. L. Klueh and P. J. Maziasz 1988 38 p Presented at the 14th International Symposium on Effects of Radiation on Materials, Andover, Mass., 27 Jun. 1988

(Contract DE-AC05-84OR-21400)

(DE88-009060; CONF-880613-5; CONF-880613) Avail: NTIS HC A03/MF A01

Steels are being developed for fusion-reactor applications that contain only elements that produce radioactive isotopes that decay to low levels in a reasonable time. These reduced-activation or fast induced-radioactivity decay ferritic steels are being developed to be analogous to the Cr-Mo steels presently in the fusion program, but with molybdenum replaced by tungsten. In this paper, steels with 2 to 1/4 percent Cr will be discussed. To determine the effect of tungsten and vanadium on these steels, heats were produced with 2 percent W, with 0.25 percent V, with 1 percent W and 0.25 percent V, and with 2 percent W and 0.25 percent V. Tempering and microstructural studies were made and tensile and impact tests were conducted. Preliminary results indicate that it should be possible to develop a low-chromium Cr-W steel without molybdenum or niobium. Such steels should have properties as good as or better than the three Cr-Mo steels presently being considered as candidates for fusion-reactor applications. DOE

N88-25525# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.

HOT ISOSTATIC PRESSING OF NICKEL ALUMINIDE POWDERS

R. N. Wright and J. E. Flinn Feb. 1988 32 p

(Contract DE-AC07-76ID-01570)

(DE88-009677; EGG-MS-7986) Avail: NTIS HC A03/MF A01

Powder processing of boron-microalloyed Ni3Al alloys followed by consolidation using hot isostatic pressing has been investiged. The influences of time, temperature, and pressure on HIP consolidation have been evaluated and the results are presented in the form of a consolidation map. Microstructural evolution during HIPping and subsequent heat treatment has been characterized and related to the mechanical properties. It has been found that processing parameters must be carefully controlled to suppress sulfur segregation to prior particle boundaries while promoting boron segregation to grain boundaries. Alloying with chromium has been found to promote densification and improve high temperature properties. DOE

N88-25526# Argonne National Lab., Ill.

OXIDATION BEHAVIOR AND MICROSTRUCTURAL STUDIES OF MELT-SPUN GLASSY Fe-Al-Zr METAL

C. C. Cheng, W. E. King, and M. J. McNallan Feb. 1988 11 p Presented at the 172nd Meeting of the Electrochemical Society, Honolulu, Hawaii, 18 Oct. 1987

(Contract W-31-109-eng-38)

(DE88-009964; CONF-871027-47; CONF-871027) Avail: NTIS HC A03/MF A01

Melt-spun Fe-Al-Zr glassy ribbons have been oxidized at 500 C from 24 to 350 hours. Oxidation kinetics were obtained by directly measuring the oxide thickness in the transmission electron micrographs from specimens prepared in transverse section. The thicknesses of oxide on the He-cooled surfaces (created by slower cooling rate) are substantially thicker than those on the wheel-cooled surfaces (created by higher cooling rate). The oxide scale consists of two layers: a thin, crystalline iron-rich oxide near the oxide/gas interface and an amorphous, aluminum-rich oxide beneath. The oxide composition was studied by X-ray energy-dispersive spectroscopy. DOE

N88-25527# Brookhaven National Lab., Upton, N. Y.

POLYACRYLIC ACID ELECTROLYTE-MODIFIED ZINC PHOSPHATE CONVERSION COATINGS FOR CORROSION PROTECTION OF STEEL

T. Sugama, L. E. Kukacka, and N. Carciello Nov. 1987 11 p Presented at the Joint Meeting of the 195th National Meeting of the American Chemical Society and the 3rd Chemical Congress of North America, Toronto, Ontario, 5 Jun. 1988

(Contract DE-AC02-76CH-00016)

(DE88-004878; BNL-40469; CONF-880604-1) Avail: NTIS HC A03/MF A01

The present studies are to explore the effects of polyacrylic acid (p(AA)) polyelectrolyte macromolecules when they are internally diffused throughout the crystalline Zn/Ph layer, on the improvement in corrosion protection afforded to steel by the Zn/Ph, and on the degree of the alkaline dissolution of coatings. Cathodic delamination studies for polyester-modifed polyurethane (PU)-coated Zn/Ph specimens were also performed to determine the role of the intermolecular chemical reaction at PU-modified Zn/Ph interfaces in reducing the delamination rates of the PU topcoat from the Zn/Ph. DOE

N88-25528# Georgia Inst. of Tech., Atlanta. School of Civil Engineering.

MECHANICAL TESTING AND MICROSCOPIC ANALYSIS OF STRUCTURE OF EXTRUDED POWDER ALUMINUM

T. O. Woods, D. G. Berghaus, and H. B. Peacock 1988 5 p Presented at the 6th International Congress on Experimental Mechanics, Portland, Oreg., 5 Jun. 1988 Prepared in cooperation

with Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
(Contract DE-AC09-76SR-00001)
(DE88-007193; DP-MS-88-27; CONF-880691-1) Avail: NTIS HC A02/MF A01

The mechanical properties and structure of extruded powder aluminum were studied so that failure mechanisms could be determined. Extruded powder aluminum specimens were mechanically tested at elevated temperature in tension and compression and were then sectioned, polished, and viewed microscopically to examine changes in the powder metal. Quantitative metallography was used to show changes produced in the laminar powder structure. The void content of the material increased with greater axial elongation in the tension tests and decreased with increasing levels of compression. DOE

N88-25529# California Univ., Berkeley. Lawrence Berkeley Lab.
EXPLORATORY DEVELOPMENT IN THE SYSTEM Al-Sc-X
R. R. Sawtell and J. W. Morris, Jr. Jan. 1988 19 p Presented at the TMS-AIME/ASM Symposium on High Temperature Mechanical Properties of Ordered Intermetallics, Phoenix, Ariz., 25 Jan. 1988
(Contract DE-AC03-76SF-00098)
(DE88-008242; LBL-24626; CONF-880126-2) Avail: NTIS HC A03/MF A01

In the search for new structural materials, systems based on the cubic, Al3X phase show particular promise both as monolithic materials and as dispersions in an Al matrix. One of the most interesting candidates is the Al3Sc phase which has been observed as a highly stable, coherent precipitate in Al alloys. Al-Sc-X alloys hardened by this phase have been shown to develop unique combinations of properties. This work examines the Al(ss) yields Al3Sc phase transition for the purpose of predicting potential substitutes or replacements for Sc. Theoretical analyses of intermetallic compound formation and precipitation in the Al-Sc-RE (RE = rare earth elements) are described as are the results of experimental evaluations of such systems. These results include descriptions of new Al-Sc-RE alloys with tensile strengths as high as 310MPa (45 ksi); some of the highest levels attained in an Al alloy on a per atom basis. DOE

N88-25530# Oak Ridge National Lab., Tenn.
METALS AND CERAMICS DIVISION Progress Report, period ending 30 Sep. 1987
Mar. 1988 180 p
(Contract DE-AC05-84OR-21400)
(DE88-008955; ORNL-6460) Avail: NTIS HC A09/MF A01

The Metals and Ceramics Division is a broad, multidisciplinary research organization that is responsible for providing materials support for the ORNL and DOE programs. The Division is structured around functional groups having capabilities that can be combined to attack large, complex problems. The Division tends to emphasize high-temperature structural materials. Activities range from fundamental, theoretical, and experimental studies of alloying behavior through development of new materials and on to the establishment of engineering properties and appropriate data bases. Strong emphasis is placed on the development and transfer of technology to the private sector. Some activities cross both functional and programmatic lines. This report presents brief descriptions of our functional groups in Chapters 1 through 3. Program activities are reviewed in Chapter 4, and collaborative research facilities are highlighted in Chapter 5. Major new programs were initiated in High-Temperature Superconductivity and Microwave Sintering. DOE

N88-25531*# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Materials Science and Engineering.
FRACTION EUTECTIC MEASUREMENTS IN SLOWLY COOLED Pb - 15 WT PERCENT Sn ALLOYS Final Report
Anthony C. Studer and V. Laxmanan Jun. 1988 22 p Presented at the 1987 Fall Meeting of the Metallurgical Society, Cincinnati, Ohio, 12-14 Oct. 1987
(Contract NCC3-74)
(NASA-CR-180830; E-3762; NAS 1.26:180830) Avail: NTIS HC A03/MF A01 CSCL 11F

A space shuttle experiment employing the General Purpose Furnace in its isothermal mode of operation is currently manifested for flight circa 1989. The aim of this experiment was to investigate the role of gravity in a slowly, and isothermally, cooled sample of a binary Pb - 15 wt percent Sn alloy. Ground based work in support of the microgravity experiment is discussed. In particular, it is shown that fraction eutectic measurements using an image analyzer, can be used to satisfactorily describe macrosegregation occurring in these slowly cooled ingots. Author

N88-25628# Joint Publications Research Service, Arlington, Va.
NEW SUPER ALLOYS USED IN TURBOCHARGERS
Masashi Yoritaka, Yukio Yamamoto, Yasuaki Hasegawa, and Tomio Hokari *In its* JPRS Report: Science and Technology. Japan 4 May 1988 p 60-71 Transl. into ENGLISH from Jidosha Gijutsu (Tokyo, Japan), Oct. 1987 p 1150-1155 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials*.

N88-25532# Michigan Technological Univ., Houghton.
A GENERAL QUALITATIVE STUDY OF POINT AND EXTENDED DEFECTS AND THEIR INTERACTIONS IN NON-METALLIC SYSTEMS Annual Technical Report, 1 Jan. - 31 Dec. 1987
A. B. Kunz, Bryan H. Suits, Christopher Woodward, and Samson A. Marshall 31 Dec. 1987 67 p
(Contract N00014-86-K-0149)
(AD-A191687) Avail: NTIS HC A04/MF A01 CSCL 07B

This report describes progress in developing and implementing a general theoretical approach to describing the properties of defects and impurities of a general nature in nonmetallic solid systems. Also we review progress in complementary non-destructive experimental tests. These tests employ and extend newly developed techniques in EPR and NMR imaging in solids. First of a kind EPR imaging experiments have been performed, and a new NMR imaging laboratory has been constructed. GRA

N88-25533# Massachusetts Inst. of Tech., Cambridge.
OBSERVATION OF METALLIC CONDUCTIVITY IN LIQUID CARBON Report, 1 Sep. 1986 - 31 Aug. 1987
J. Heremans, C. H. Olk, G. L. Eesley, J. Steinbeck, and G. Dresselhaus 30 Oct. 1987 16 p Prepared in cooperation with General Motors Research Labs., Warren, Mich.
(Contract F49629-85-C-0147)
(AD-A191723; AFOSR-88-0225TR) Avail: NTIS HC A03/MF A01 CSCL 07B

The temperature dependence of the electrical resistivity of carbon fibers has been measured at atmospheric pressure and for temperatures up to and above the melting point at 4450 Kelvin. Vapor-grown graphite fibers of different crystalline perfection were heated with electrical pulses 28 microseconds in duration. The transient reflectivity of graphite irradiated with picosecond laser pulses was also measured and the results show evidence for nonequilibrium heating. From this work, it is concluded that liquid carbon is metallic with a nearly temperature independent electrical resistivity of 30 micro-ohm centimeters. GRA

N88-25534# Massachusetts Inst. of Tech., Cambridge.
MICROSTRUCTURE OF THIN INTERCALATED BENEZENE DERIVED GRAPHITE FIBERS Report, 1 Sep. 1986 - 31 Aug. 1987
E. Minami, M. S. Dresselhaus, X. Hao, J. S. Speck, and M. Endo

30 Oct. 1987 4 p Prepared in cooperation with Shinshu Univ., Nagano, Japan
(Contract F49629-85-C-0147)
(AD-A191724; AFOSR-88-0231TR) Avail: NTIS HC A02/MF A01 CSCL 11B

A brief study has been carried out to investigate the structure of pristine and intercalated thin benzene derived graphite fibers. High resolution transmission electron microscopy techniques were used. The fibers used for this study were prepared by thermal decomposition of benzene onto a substrate seeded with metal particles. The unique feature of the fibers used in this study is that their diameter is only 170 nanometers. Fibers used in earlier studies and for most technological applications have generally had diameters more than an order of magnitude larger. Study of the physics of size effects in carbon fibers was a prime motivating force for the current investigation. GRA

N88-25535# Massachusetts Inst. of Tech., Cambridge.
ANOMALOUS TEMPERATURE-DEPENDENT NEGATIVE MAGNETORESISTANCE IN PREGRAPHITIC CARBONS Report, 1 Sep. 1986 - 31 Aug. 1987
K. Sugihara and M. S. Dresselhaus 30 Oct. 1987 4 p
(Contract F49629-85-C-0147)
(AD-A191725; AFOSR-88-0235TR) Avail: NTIS HC A02/MF A01 CSCL 11G

Some kinds of pregraphitic carbons exhibit temperature-dependent negative magnetoresistance even at helium temperatures. To account for this anomalous behavior, two assumptions have been introduced. First the sample is composed of an assembly of many thin films which are nearly independent of each other elastically. Secondly, ionized impurity scattering makes an important contribution to the resistivity. Rayleigh waves with small damping and small sound velocity propagate through each film and the scattering due to the Rayleigh wave phonons gives rise to a carrier relaxation rate which decreases as the square of the thin film thickness. Since the screening length of an ionized impurity potential decreases with magnetic field, this process leads to a negative magnetoresistance. Combining these two effects, the qualitative features of the temperature dependent negative magnetoresistance can be explained within the framework of Bright's Theory. GRA

N88-25536# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.
STUDIES OF METAL-SILICON, SILICON-METAL AND SILICIDE BASED INTERFACES: SYNCHROTRON RADIATION PHOTO EMISSION AND INVERSE PHOTOEMISSION INVESTIGATIONS OF INTERFACE FORMATION AND COMPOUND NUCLEATION Final Report, 1 Oct. 1984 - 23 Oct. 1987
John H. Weaver 15 Jan. 1988 30 p
(Contract DAAG29-84-K-0169)
(AD-A191808; ARO-21355.2-MS) Avail: NTIS HC A03/MF A01 CSCL 07B

This report summarizes a three-year investigation of metal/semiconductor interface formation. Highlights for the 21 refereed papers are included, together with copies of feature articles published in Physics Today and The American Scientist which cite support from ARO. GRA

N88-25537# Dayton Univ., Ohio. Dept. of Chemistry.
STRUCTURE AND REFINEMENT OF ORDERED AROMATIC HETEROCYCLIC POLYMERS BY DIFFRACTION METHODS: APPLICATION OF RESULTS TO ELECTRO-OPTIC PHENOMENA Final Report, 30 Sep. 1984 - 31 Oct. 1987
Albert V. Fratini Feb. 1988 62 p
(Grant AF-AFOSR-0364-84)
(AD-A191859; AFOSR-88-0049TR) Avail: NTIS HC A04/MF A01 CSCL 07F

The polymer structure determination and refinement of flexible coil poly-2,5-benzoxazole (ABPBO) and poly-2,6-benzothiazole (ABPBT) were performed. Refinement of the unit cell structure of poly(p-phenylene benzobisthiazole) (PBO) and poly(p-phenylene benzobisthiazole) (PBT) in a nonprimitive monoclinic unit cell was carried out in a similar fashion. Initial structural models were derived from X-ray studies of model compounds. Experimental structure factors were incorporated into the Linked-Atom Least-Squares (LALS) refinement method. The Structure of the benzimidazo-isoquinoline ladder polymer (BBL) was also investigated. BBL shows potential as an organic conducting polymer. The feasibility of BBL and similar systems to act as conducting polymers requires accurate molecular structure and crystallographic data for an understanding of the mechanical, optical and electro-optic properties. GRA

N88-25538# Massachusetts Univ., Amherst. Dept. of Polymer Science and Engineering.
IMPROVED STRUCTURAL POLYMER ALLOYS AND COMPOSITES Final Report, 1 May 1985 - 30 Apr. 1987
Frank E. Karasz 30 Apr. 1987 36 p
(Contract F49620-85-C-0127)
(AD-A192092; AFOSR-88-0067TR) Avail: NTIS HC A03/MF A01 CSCL 11I

Considerable success was achieved relative to the goals of this project. Most importantly, a new generic class of high performance polymer blends was discovered. It is believed that polybenzimidazoles and polymides are miscible over a wide range of compositions, structural variations and temperature regimes. This assertion is based on work with the blends described in this report, utilizing commercially available materials. Evidence for their miscibility was displayed in their glass transition behavior, as elucidated by DSC and DMA, and in their IR spectral properties. Their phase behavior was also examined. Several blend combinations have been scaled up for evaluation to delineate technologically useful systems. The synthesis and properties of two high performance ionomers were also investigated: Sodium sulfonate (Udel) polysulfone (Na-SPSF) and sodium sulfonate poly(ether ether ketone) (Na-SPEEK). Improved and novel synthetic techniques were developed so that random, homogenous copolymers could be prepared. Their glass transition behavior and thermal stabilities were assessed. Their blend properties were also assessed and analyzed theoretically in terms of a mean-field treatment. Interaction parameters were calculated. GRA

N88-25539# Sandia National Labs., Albuquerque, N. Mex.
PARAMAGNETIC SPINS IN OXYGEN-LOADED CERAMIC La2CuO4/SUB 4+DELTA/
E. L. Venturini, J. E. Schirber, B. Morosin, D. S. Ginley, and J. F. Kwak 1988 5 p Presented at the Spring Meeting of the Materials Research Society, Reno, Nev., 4 Apr. 1988
(Contract DE-AC04-76DP-00789)
(DE88-007114; SAND-88-0060C; CONF-880408-3) Avail: NTIS HC A02/MF A01

Annealing ceramic La2CuO (sub 4 + delta)in 3 kbar of oxygen at 600 C increases the weight by 0.35%, produces a bulk superconductor with a approx. =30% Meissner fraction, and adds a new component to the paramagnetic susceptibility which is characteristic of localized, paramagnetic spins. Analytical chemistry suggests that the stoichiometry of this HP-annealed ceramic is La2CuO(sub 4.14), where at least part of the additional oxygen is incorporated as superoxide ions, O2(-). . The additional paramagnetic spins from the susceptibility data, 1.3(3) x 10 to the 20th power spins/g, agree with the number of superoxide ions inferred from weight gain and iodometric analysis. DOE

N88-25540# Materials Research Labs., Melbourne (Australia).
FIRE RETARDANT COATINGS FOR MILITARY EQUIPMENT: A REVIEW
L. V. Wake Feb. 1988 33 p
(MRL-R-1104; AR-005-205) Avail: NTIS HC A03/MF A01

A continued increase in the use of fire retardant coatings by the Australian Defence Forces (ADF) is expected in view of the higher levels of composite and other lightweight materials being employed in modern military equipment. However, the increased smoke production reportedly associated with some fire retardant coatings has led to differences of opinion on the relative benefits associated with their use. This aspect combined with the growing

awareness of health and safety factors associated with fire has, in part, resulted in a variety of coatings and testing methods being adopted by allied Service organizations. This review examines the field and discusses the mechanisms of action and relative performance of fire retardant coatings in relation to the above. Coatings suitable for use by the ADF are also discussed. Author

N88-25541# Materials Research Labs., Melbourne (Australia).
ARMOURED VEHICLE TRACK ELASTOMERS: RESEARCH AND DEVELOPMENT AT MRL
T. E. F. Symes Feb. 1988 19 p
(MRL-GD-0012; AR-005-202) Avail: NTIS HC A03/MF A01

The Australian Army employs two basic types of Armoured Fighting Vehicle (AFV) fitted with rubberized (elastomeric) track designs. The M113 Armoured Personnel Carrier entered the Australian service in the 1960's and the Leopard AS1 Main Battle Tank in the 1970's. Adoption of elastomeric components in the form of bushings, roadwheel treads, roadwheel pads (roadwheel-side trackshoe pads) and track pads (ground-side track-shoe pads) has provided many improvements in track performance and maintenance requirements. However, the number of such components exhibiting field damage forwarded to MRL for investigation in the early 1980's indicated that the elastomers being used were not optimum for Australian conditions. This paper presents aspects of the work undertaken to improve track elastomer formulations for local industry production and AFV use. Author

N88-25542*# National Aeronautics and Space Administration, Washington, D.C.
INTERACTION OF VINYLIDENE FLUORIDE: TETRAFLUOROETHYLENE COPOLYMER WITH AMMONIA
Yu. A. Kostrov, I. M. Velikanova, G. D. Litovchenko, F. E. Reybarkh, I. N. Andreyeva, V. Ya. Yefremov, and A. G. Bondarenko Jun. 1988 10 p Transl. into ENGLISH from Vzaumodeystviye Sopolimera Vinilidenftorida-Tetraftoretilene s Ammiakom, Vysokomolekulyarnyye Soyedineniya, (USSR), v. 29, no. 10, 1987 p 2122-2127 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20292; NAS 1.77:20292) Avail: NTIS HC A02/MF A01 CSCL 11G

The methods of IR-spectroscopy, mass spectrometry, and DTA were used to study the chemical and structural changes of the vinylidene fluoride and tetrafluoroethylene coploymer during its treatment with ammonia. Assumptions were made regarding the occurring chemical reactions and the reasons for the high permeability of ammonia through the modified copolymer. Author

N88-25543*# National Aeronautics and Space Administration, Washington, D.C.
EMPLOYMENT OF POROUS POLYTETRAFLUOROETHYLENE MEMBRANE WITH A HYDROPHILIC AND HYDROPHOBIC STRATAL STRUCTURE FOR CONSTRUCTION OF AN ENZYME ELECTRODE
Masakatsu Hato and Tsukasa Sakai Jun. 1988 10 p Transl. into ENGLISH from Kobunshi Rombunshu (Japan), v. 41, no. 4, 1984 p 229-232 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4703)
(NASA-TT-20296; NAS 1.77:20296) Avail: NTIS HC A02/MF A01 CSCL 07D

A porous polytetrafluoroethylene membrane possessing a hydrophilic and hydrophobic double structure is used for the construction of an ammonia-electrode based enzyme electrode. Adenosine deaminase was part of this asymmetric membrane, thus leading to protection of the mechanically weak enzyme layer by the robust polytetrafluoroethylene matrix. The hydrophobic part of the membrane acted as a gas-permeable membrane. Therefore, an adenosine electrode could be constructed easily by using only a single membrane and a pH electrode. The advantage of employing this single membrane adenosine electrode is that the response speed is greatly increased and the electrode construction is simpler, compared to that of the conventional two-membrane electrodes. Author

N88-25544*# National Aeronautics and Space Administration, Washington, D.C.
FLAME RETARDATION TREATMENT OF SYNTHETIC RUBBERS AND SYNTHETIC RESINS
Kanezo Hirosawa Jul. 1988 18 p Transl. into ENGLISH from Kogyo Zairyo (Japan), v. 35, no. 8, 1986 p 92-96 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20285; NAS 1.77:20285) Avail: NTIS HC A03/MF A01 CSCL 11C

Synthetic rubbers and resins are considerably utilized with production amounting to millions of tons per year. Since these polymeric materials may hinder a disaster relief activity, rubbers and synthetic resins are classified as a special combustible material. Detailed regulations for the enforcement of Japanese Fire Defense Law lists combustible or smoldering materials, including synthetic rubbers and synthetic resins. Most manufacturers are now interested in producing incombustible products or suppressing flammability of synthetic rubbers and resins. Author

N88-25545# Pennsylvania State Univ., University Park. Center for Advanced Materials.
ASSESSMENT OF OPPORTUNITIES FOR GAS-FIRED SINTERING IN THE ADVANCED CERAMICS AND POWDERED METALS INDUSTRIES Topical Report, Jun. 1986 - May 1987
G. L. Messing and D. A. Koss Jun. 1987 43 p
(Contract GRI-5084-238-1302)
(PB88-197157; CAM-8702; GRI-87/0298) Avail: NTIS HC A03/MF A01 CSCL 11B

Almost the entire ceramics industry and a portion of the metals industry rely on the use of high temperatures to effect densification of powder preforms (sintering). Many of these materials are sintered in electrically heated furnaces. The development and implementation of gas fired heating systems in these growing industries could potentially increase natural gas usage. The project was designed to determine the technical requirements for gas fired sintering technology in these industries and to assess the potential for implementing such a technology. Author

N88-25546# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
HYDROGENATED AMORPHOUS SILICON-GERMANIUM ALLOYS
W. Luft Feb. 1988 121 p
(Contract DE-AC02-83CH-10093)
(DE88-001147; SERI/TR-211-3317) Avail: NTIS HC A06/MF A01

This report describes the effects of the germanium fraction in hydrogenated amorphous silicon-germanium alloys on various parameters, especially those that are indicators of film quality, and the impact of deposition methods, feedgas mixtures, and other deposition parameters on a SiGe:H and a-SiGe:H:F film characteristics and quality. Literature data show the relationship between germanium content, hydrogen content, deposition method (various glow discharges and CVD), feedgas mixture, and other parameters and properties, such as optical band gap, dark and photoconductivities, photosensitivity, activation energy, Urbach parameter, and spin density. Some of these are convenient quality indicators; another is the absence of microstructure. Examining RF glow discharge with both a diode and triode geometry, DC proximity glow discharge, microwave glow discharge, and photo-CVD, using gas mixtures such as hydrogen-diluted and undiluted mixtures of silane/germane, disilane/germane, silane/germaniumtetrafluoride, and others, it was observed that hydrogen dilution (or inert gas dilution) is essential in achieving high photosensitivity in silicon-germanium alloys (in contradistinction to amorphous hydrogenated silicon). Hydrogen dilution results in a higher photosensitivity than do undiluted gas mixtures. DOE

N88-25547# Lawrence Livermore National Lab., Calif.
OPTICAL DAMAGE IN EPOXY POLYMERS BY MILLISECOND LIGHT PULSES
C. R. Wolfe, J. H. Campbell, R. E. Lyon, J. H. Pitts, and H. T.

Powell 12 Oct. 1987 24 p Presented at the Boulder Damage Symposium, Boulder, Colo., 26 Oct. 1987
(Contract W-7405-eng-48)
(DE88-008675; UCRL-95283-Rev-1; CONF-8710165-12-Rev-1)
Avail: NTIS HC A03/MF A01

Optical damage is studied in epoxy-based polymers used to attach absorbing cladding onto the edge of laser disks of the Nova laser. Damage was produced by exposing the polymers to a 20-40 J/sq cm fluence of broad band Xe-flashlamp light having a pulselength of approximately 0.5 ms. This simulates the pump environment of Nd:glass laser amplifiers. The predominant damage mechanisms appear to be pyrolysis, associated with absorbing inclusions and photolysis, associated with intrinsic absorption of the polmer. The amount of damage can be minimized by: (1) careful filtering of the polymer to reduce the presence of foreign material, (2) minimizing the near UV absorption of the polymer, and (3) reducing the UV emission of the flashlamps. DOE

N88-25548# Aerospace Corp., El Segundo, Calif. Chemistry and Physics Lab.
STUDIES OF BORON IMPLANTATION THROUGH PHOTOCHEMICALLY DEPOSITED SiO2 FILMS ON Hg(SUB 1-x)Cd(SUB x)Te
R. C. Bowman, Jr., R. E. Robertson, J. F. Knudsen, and R. G. Downing (National Bureau of Standards, Gaithersburg, Md.) 22 May 1987 28 p
(Contract F04701-85-C-0086)
(SD-TR-87-26) Avail: NTIS HC A03/MF A01 CSCL 11C

Variable temperature Hall and resistivity measurements were used to monitor the changes in carrier behavior in p-type Hg1-xCdxTe when boron ions are implanted through photochemically deposited SiO2. The formation of an n-type layer is demonstrated. Quantitative and nondestructive determinations of the absolute B-10 concentration and distribution were obtained by the novel method of neutron depth profiling. As expected, the boron distributions in the SiO2 films and Hg1-xCdxTe are strongly dependent upon the ion implant energy. However, negligible changes in the boron depth profiles were found after 200 C anneals. The present results are briefly related to the performance behavior of midwavelength infrared (MWIR) sensors produced via generic ion implantation procedures. Author

N88-25549# California Univ., Berkeley.
ON THE USE OF THERMAL DEGRADATION DATA TO PREDICT CABLE IGNITION PERFORMANCE
A. C. Fernandez-Pello, H. K. Hasegawa, A. E. Lipska-Quinn, and N. J. Alvares 15 Oct. 1987 21 p Presented at the 2nd International Symposium on Fire Safety Science, Tokyo, Japan, 13 Jun. 1988 Prepared in cooperation with Lawrence Livermore National Lab., Calif.
(Contract W-7405-eng-48)
(DE88-002276; UCRL-97290; CONF-880634-1) Avail: NTIS HC A03/MF A01

This study explores the feasibility of predicting the piloted ignition performance of polymeric material and electrical cable insulations using thermogravimetric analysis (TGA) data in conjunction with a simple ignition model. We propose that the surface temperature at which thermal degradation produces pyrolyzate is related to the ignition temperature for that particular material. This temperature is used in a formula derived from a heat transfer model of the ignition process to predict the dependence of polymer ignition delay time on the magnitude of an externally applied irradiance. The predicted ignition delay times are compared with experimental results of piloted ignition delay time of vertically suspended polymers exposed to different irradiance levels. For most polymers, the temperature at which thermal degradation is first observed can be used to predict ignition delay times, particularly at high irradiance levels. The discrepancy obtained between predictions and measurements for one of the cable jackets points out the limitations of the present approach and suggests that the method is valid only if the initially pyrolized gases are combustible. DOE

N88-25550# Oak Ridge National Lab., Tenn.
UNIAXIAL TENSILE STRAIN MEASUREMENT FOR CERAMIC TESTING AT ELEVATED TEMPERATURE: REQUIREMENTS, PROBLEMS AND SOLUTIONS
K. C. Liu, H. Pih, and D. W. Voorhes 1988 41 p Presented at the Conference on Mechanical Testing of Engineering Ceramics at High Temperatures, London, United Kingdom, 11 Apr. 1988 Prepared in cooperation with Tennessee Univ., Knoxville and OPTRA, Inc., Peabody, Mass.
(Contract DE-AC05-84OR-21400)
(DE88-008090; CONF-880491-2) Avail: NTIS HC A03/MF A01

Accuracy, sensitivity and resolution requirements for strain measurement on a tensile ceramic specimen at high temperature were studied. Results indicate that current techniques and existing equipment for strain measurement can be modified and upgraded for use in high temperature testing of ceramic materials. A versatile mechanical strain extensometer capable of performing both biaxial and uniaxial strain measurements at 1200 C is presented. Results of tensile and fatigue tests using the devices are also given. Additionally, two laser-based, noncontact, optical strain extensometers currently under development are described. The first method utilized the diffraction phenomenon of a light beam passing through a narrow slit. Accuracy, long-term stability, and low cost are the virtues of this method which makes it attractive for creep testing. The second method measures the in-plane surface displacement in terms of the change in phase resulting from the interference of two orthogonally polarized collinear beams which differ in frequency by a constant value. The last method is ideally suited for dynamic strain measurement. DOE

N88-25551# Tennessee Univ., Knoxville. Dept. of Engineering Science and Mechanics.
AN ASSESSMENT OF THE STATE OF THE ART IN PREDICTING THE FAILURE OF CERAMICS Final Report
J. A. M. Boulet Mar. 1988 60 p
(Contract DE-AC05-84OR-21400)
(DE88-008998; ORNL/Sub-86-57598/1) Avail: NTIS HC A04/MF A01

The greatest weakness in existing design strategies for brittle fracture is in the narrow range of conditions for which the strategies are adequate. The primary reason for this weakness is the use of simplistic mechanical models of fracture processes and unverified statistical models of materials. To improve the design methodology, the models must first be improved. Specifically recommended research goals are: to develop models of cracks with realistic geometry under arbitrary stress states; to identify and model the most important relationships between fracture processes and microstructural features; to assess the technology available for acquiring statistical data on microstructure and flaw populations, and to establish the amount of data required for verification of statistical models; and to establish a computer-based fracture simulation that can incorporate a wide variety of mechanical and statistical models and crack geometries, as well as arbitrary stress states. DOE

N88-25620# Joint Publications Research Service, Arlington, Va.
RESEARCH AND DEVELOPMENT PROGRAMS ON ADVANCED STRUCTURAL CERAMICS IN KOREA
Byong Sik Jeon *In its* JPRS Report: Science and Technology. Japan 4 May 1988 p 1-15 Transl. into ENGLISH from Ceramics Japan (Tokyo, Japan), v. 22, Aug. 1987 p 643-650 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

N88-25621# Joint Publications Research Service, Arlington, Va.
CERAMIC SUBSTRATES FOR SEMICONDUCTOR APPLICATIONS REPORTED: AIN SUBSTRATES
Katsuaki Sugimoto *In its* JPRS Report: Science and Technology. Japan 4 May 1988 p 16-31 Transl. into ENGLISH from Kino Zairyo (Tokyo, Japan), Sep. 1987 p 54-62 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

N88-25622# Joint Publications Research Service, Arlington, Va.
AIN SUBSTRATE APPLICATIONS
Nobuo Iwase *In its* JPRS Report: Science and Technology. Japan 4 May 1988 p 32-44 Transl. into ENGLISH from Kino Zairyo (Tokyo, Japan), Oct. 1987 p 57-66 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

N88-25867# Signal Research Center, Inc., Des Plaines, Ill.
CHARACTERIZATION OF PROTON CONDUCTING POLYMER BLENDS
S. Petty-Weeks and A. J. Polak *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 4 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 11B

N88-25892# Case Western Reserve Univ., Cleveland, Ohio. Electronics Design Center.
EFFECT OF PROCESS CONDITIONS ON ALUMINUM OXIDE THIN FILM USED IN pH ISFET
Anthony S. Wong and Peter W. Cheung *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 4 p Prepared in cooperation with Washington Univ., Seattle (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N88-25552# National Bureau of Standards, Gaithersburg, Md. Inst. for Materials Science and Engineering.
KINETIC MEASUREMENTS OF THERMAL DECOMPOSITION OF ENERGETIC MATERIALS AT HIGH PRESSURES Final Report, 17 Oct. 1984 - 16 Oct. 1987
Gasper J. Piermarini and Stanley Block 12 Jan. 1988 4 p Sponsored by Army Research Office, Triangle Park, N.C.
(AD-A191612; ARO-21670.4-CH) Avail: NTIS HC A02/MF A01 CSCL 19A

A new spectroscopic method was developed which permits kinetic measurements of reactions in energetic materials at high pressures. The method utilizes FTIR in conjunction with a diamond anvil high pressure cell. Measurements were made on HMX and nitromethane. The rate of thermal decomposition for HMX was found to have a negative pressure dependence, which, when coupled with the observed thermodynamic activation quantities, led to a unimolecular decomposition mechanism - ring expansion prior to bond scission. Contrary to the HMX case, the decomposition rate for nitromethane was observed to have a positive pressure dependence leading to a bimolecular reaction mechanism which is the result of increased intermolecular interactions. A dynamic stress-induced catastrophic reaction was observed in protonated nitromethane at room temperature, but not in the deuterated form. GRA

N88-25553# Materials Research Labs., Melbourne (Australia).
THE VISCOSITY OF MOLTEN TNT
M. A. Parry and H. H. Billon Dec. 1987 31 p
(MRL-R-1100; AR-005-199) Avail: NTIS HC A03/MF A01

The flow behavior of pure and commercial molten TNT, when subjected to very high rates of shear in the temperature range 82.0 to 95.4 C, is presented. All the data obtained suggest that molten TNT is Newtonian, contrary to some published work, and the temperature dependence of the viscosity of pure TNT is adequately described by an Arrhenius-type realtionship of the form eta = Ae sup B/T where A = 0.000541, B = 3570 and T is Kelvin temperature. This equation is characteristic of a simple isotropic liquid. A similar relationship is obtained for commercial TNT. Under some instrumental conditions discontinuities are seen in the shear stress/shear rate flow curves. An analysis of these discontinuities shows them to be caused by the transition from laminar to turbulent flow. Possible implications for processibility and initiation of explosives are discussed. Author

N88-25554# Johns Hopkins Univ., Laurel, Md. Chemical Propulsion Information Agency.
THE 24TH JANNAF COMBUSTION MEETING, VOLUME 2
Dorothy L. Becker, ed. Oct. 1987 378 p Meeting held in Monterey, Calif., 5-9 Oct. 1987
(Contract N00039-87-C-5301)
(AD-A190164; CPIA-Publ-476-Vol-2) Avail: NTIS HC A17/MF A01 CSCL 19A

Topics addressed include: combustion instability in rocket engines and ramjets; ignition, fluid dynamics, and ballistics in liquid propellant guns; rocket engine performance; supersonic combustion; and the ignition and decomposition of slurried ramjet fuels. For individual titles, see N88-25555 through N88-25584.

N88-25555# Sandia National Labs., Albuquerque, N. Mex. Combustion Research Facility.
THE COMBUSTION OF HYDROXYLAMMONIUM NITRATE BASED LIQUID PROPELLANTS **c25**
Steven R. Vosen *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 1-9 Sponsored by DOE, Washington, D.C. and the Department of the Army, Washington, D.C. (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21B

To better understand the physical processes which occur during the combustion of liquid propellants (LP), a strand burner was used to study hydroxylammonium nitrate based LP flames. By observing the combustion of LP in such an arrangement, much was deduced of the physical processes that occur during LP ignition and combustion, at pressure which are relevant to LP gun ignition. Combustion experiments were performed in which mixtures of the salts hydroxylammonium nitrate (HAN) and triethanolammonium nitrate (TEAN) in water were ignited by an electric discharge, in a pressure vessel at pressures of up to 34 MPa (5000 psi). Images of the combustion were obtained through windows in the pressure vessel by backlit photography, and were recorded on a video system at a rate of 60 frames per second, with an exposure of 100 microseconds. These images clearly show the movement of a liquid-gas interface and a bright flame during LP combustion. Conclusions based on photographs of LP and HAN water combustion, samples of combustion residue in the combustion chamber, and the pressure in the chamber are discussed.
Author

N88-25556# Sandia National Labs., Albuquerque, N. Mex. Combustion Research Facility.
A DYNAMIC MODEL OF LIQUID PROPELLANT COMBUSTION **c25**
Robert Armstrong and Steven R. Vosen *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 11-18 Sponsored by DOE, Washington, D.C. and the Department of the Army, Washington, D.C. (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21B

A strand burner type configuration was employed to study the structure of liquid propellant flames (LP 1846). The flame was seen to consist of a region of liquid decomposition, followed by a region above the liquid surface that appeared to be composed of a fine spray, and finally by a bright flame zone. The stability of a comprehensive model of liquid propellant combustion is investigated to explain the two phase behavior (gaseous decomposition and a fog of droplets). The analysis presented includes the inertial forces traditionally associated with liquid propellant combustion instability as well as forces responsible for small length scale response (e.g., thermal conduction, surface tension). It is found that the large length scale behavior invesigated previously is recovered for large Reynolds numbers. However, the response of the model is also shown to be affected profoundly

by forces influencing the small scale. Emphasis on the small length scale effest if the feature ot the model. Viscosity plays a hydrodynamically stabilizing role whereas heat conduction can be thermally stabilizing or hydrodynamically destabilizing. A comparison of these results is made with visual observations of liquid propellant combustion from which large scale instabilities are identified and tentative evidence for small scale instabilities not explicitly resolved can be inferred. Author

N88-25557# Swarthmore Coll., Pa.
DROPLET FORMATION FOR LIQUID MONOPROPELLANT JETS
Nelson A. Macken *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 19-27 (For primary document see N88-25554 19-28)
(Contract DAAG29-81-D-0100)
Avail: NTIS HC A17/MF A01 CSCL 19A

The hydrodynamic development of droplets for conditions approximating those in the combustion chamber of regenerative liquid propellant guns was investigated. Aerodynamic interaction is analyzed using classical stability theory and a formulation applied to anticipated working conditions. The model predicts mass removed and droplet size as a function of time. Results indicate that the jet does break up with almost all liquid atomized. Comparison to a simple burning rate model verifies that the hydrodynamic model is primarily responsible for liquid removal from the intact core. Author

N88-25558# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
MIXING AND THERMODYNAMIC CRITICAL PHENOMENA OF COMBUSTING MONOPROPELLANT SPRAYS
G. M. Faeth, T.-W. Lee, and M. E. Kounalakis *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 29-38 (For primary document see N88-25554 19-28)
(Contract DAAL03-86-K-0154)
Avail: NTIS HC A17/MF A01 CSCL 19A

A theoretical investigation of combusting monopropellant spray properties, considering the hydroxyl ammonium nitrate (HAN) based monopropellants LGP 1845 and 1846, is described. Spray structure and mixing properties, and liquid surface properties and the critical combustion pressure (the pressure required for the thermodynamic critical point to be exceeded) were studied. Mixing properties were analyzed using a Favre-average k-epsilon-g turbulence model, assuming locally-homogeneous flow and thin laminar flamelets. Predictions showed encouraging agreement with existing measurements. However, predictions exhibit a strong sensitivity to injector exit conditions which were not known adequately for the measurements; therefore, additional measurements are needed for definitive assessment of analysis. Liquid surface properties were studied also using the thin-flame approximation, while allowing for high-pressure thermodynamic properties and the presence of dissolved combustion product gases in the liquid phase. Findings yield a critical combustion pressure of 2500 atm with an uncertainty of 50 percent. Greatest uncertainties were due to the binary interaction parameter between TEAN and water. Measurements are needed to test critical combustion pressure predictions, however, it seems probable that HAN-based propellants burn as sprays for all but the very highest pressures encountered in liquid-propellant guns. Author

N88-25559# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, N.J.
THE DEVELOPMENT OF A USER FRIENDLY THERMODYNAMIC CODE FOR THE PERSONAL COMPUTER
T. Vladimiroff, Y. P. Carignan, D. S. Chiu, and A. K. Macpherson (Lehigh Univ., Bethlehem, Pa.) *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 39-44 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 19A

Over the past two decades the BLAKE thermodynamic code has become the standard method by which the flame temperature for propellant formulations are calculated. This computer program was designed to be run on a mainframe type computer using a batch mode of processing. Recent advances in microcomputers have resulted in many changes in how and who uses computers. Now many engineers have a microcomputer sitting on their desk and they have grown accustomed to commercially available, user friendly computer software to facilitate their work. With this in mind, a computer code was developed to perform routine thermochemical calculations. The code is designed to be modular, portable, well documented and easy to modify. The program will run on an IBM compatible PC with no modification and on other small computers with a minimum of modifications. The lastest JANNAF thermochemical data are used along with the Haar and Shenker equation of state as developed for propellant gases by Powell, Wilmot, Harr, and Klein. The code is written in FORTRAN and will handle 16 elements and 200 product species. Comparisons are reported for five propellant formulations with BLAKE, NASA-Lewis, and the ICT thermodynamic codes. Author

N88-25560# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
MEASUREMENT OF BURNING RATES OF NOSOL-363 PROPELLANTS UNDER CROSS-FLOW AND STRAND BURNER CONDITIONS USING REAL-TIME X-RAY RADIOGRAPHY
W. H. Hsieh, C. Zanotti, J. M. Char, and K. K. Kuo *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 45-55 (For primary document see N88-25554 19-28)
(Contract DAAK29-83-K-0081)
Avail: NTIS HC A17/MF A01 CSCL 19A

A theoretical model was solved numerically for simulating erosive-burning processes occurring inside the center perforation of an unslotted NOSOL-363 stick propellant. Results show that the erosive-burning phenomena is caused by the enhanced heat feedback from the gas phase to the solid phase resulting from the combined effect of increased turbulent mixing and reduction in flame stand-off distance from the burning surface. The real-time X-ray radiography system was demonstrated to be a powerful and reliable tool for main non-intrusive measurements of instantaneous burning rates. A model was validated by experimental data in terms of time variation of internal diameter distribution. Thermal wave structures of NOSOL 363 stick propellants under erosive- and strand-burning conditions were measured by fine-wire thermocouples. Author

N88-25561# Army Armament Research and Development Command, Dover, N. J.
BURNING RATE MEASUREMENTS OF NON-NEWTONIAN LIQUID PROPELLANT (NNLP)
D. S. Chiu, A. J. Bracuti, P. Hui, and L. Bottei *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 79-88 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 19A

The combustion characteristics of the Non-Newtonian Liquid Propellant (NNLP) were conducted with a strand burner which was adapted from solid propellant research. Both gelled Hydroxyl Ammonium Nitrate (HAN) base propellants and Azidoethanol (TAE) based propellant were studied. Burning rates were obtained for all samples in the 250 to 5,000 psi regime and for one sample up to 40,000 psi. Author

N88-25562# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, N.J.
DYNAMICAL PROPERTIES OF A COLLAPSING SPHERICAL CAVITY
T. Vladimiroff, Y. P. Carignan, and A. K. Macpherson (Lehigh Univ., Bethlehem, Pa.) *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 89-97 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 19A

Hot spot formation associated with entrapped bubble collapse under rapid compression of liquid propellant may result in an undesirable ignition event. The properties of these collapsing bubbles were studied in the past, using continuum fluid mechanics.

In this work, the problem was investigated using a discrete technique. The method of molecular dynamics is employed to study the dynamics of a spherical cavity at several rates of collapse. For simplicity, all interactions are of the hard sphere type, and the laws of classical mechanics are assumed to be valid. The methods used are essentially the same as already employed to study hard spheres in a channel and hard spheres in a spherical cavity. Three cases are examined with wall Mach numbers of 0.9, 1.5, and 15. The results are bound to be qualitatively the same. During early collapse the wall temperature is observed to be twice as high as the bubble interior, possibly high enough to initiate combustion of the liquid propellant. Later, the temperature is highest at the center of the collapsing bubble, so that if there is a flammable gas inside, initiation would probably occur at the center. Author

N88-25563# Atlantic Research Corp., Alexandria, Va.
COMPARISON OF CALCULATED AND MEASURED IGNITION TIMES FOR BORON AGGLOMERATES
Merrill K. King *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 99-107 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 19A

A model for prediction of ignition times of boron agglomerates in dry atmospheres was tested against a limited data-base. The model is found to yield reasonable agreement with measured agglomerate ignition times, though the predicted sensitivity of ignition time to ambient oxygen level is somewhat higher than observed. It appears that this result may be caused by the fact that one of the two oxygen levels tested leads to rather marginal ignition, resulting in a strong sensitivity of predicted ignition time to various parameters, particularly the oxygen level, size of unit particles within the agglomerate, and gas temperature, such that over the range of probable experimental accuracy in determination of these parameter values, the band of predicted ignition times overlaps the measured values. Author

N88-25564# University of Southern California. Los Angeles. Combustion Lab.
LIQUID PHASE DECOMPOSITION IN SLURRY FUELS
Melvin Gerstein and P. Roy Choudhury *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 109-118 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 19A

Experiments show a sudden decrease in the diameter reduction rate of evaporating nonstabilized (no added chemical stabilizer) JP10/Carbon and JP10/Aluminum slurry fuel droplets. Such a sudden decrease occurs at a point where sufficient amount of unevaporated liquid still remains. An explanation of the observed phenomenon is presented and diameter histories which agree well with experimental data are predicted. A second order, one step liquid phase decomposition reaction is suggested as the most probable cause of the observed behavior. Different values of frequency factors were used parametrically in the analysis because, at this time, very little is known about the details of such a reaction. A nonstabilized slurry consisting of cumene and silicon carbide did not show any evidence of liquid phase decomposition. Author

N88-25565# Drexel Univ., Philadelphia, Pa. Dept. of Mechanical Engineering and Mechanics.
ATOMIZATION IN A TURBULENT SHEAR LAYER: PRELIMINARY MEASUREMENTS **c34**
A. M. Mellor, S. Marakovits, K. V. Tallio, and B. Farouk *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 119-126 (For primary document see N88-25554 19-28)
(Contract DAAG29-84-K-0165)
Avail: NTIS HC A17/MF A01 CSCL 20D

The influence of mean air velocity and shear layer strength on airblast atomization is investigated. A flat prefilming airblast atomizer located along the centerline of a two-stream wind tunnel is used to generate the spray. The air velocities on either side of the atomizer can be varied independently to adjust the shear layer strength. Profiles of the mean and fluctuating components of velocity are obtained with a hot-film anemometer. These measurements show that the velocity profiles are two dimensional in the region of interest for atomization. Forward scattering is used to measure the Sauter mean diameter (SMD) of the spray. Measurements obtained for the case with a shear layer strength of zero show the SMD decreases with increases in air velocity and are consistent with other studies reported in the literature for prefilming atomizers. The results used to refine and select cases for detailed characterization of the relevant processes are reported, with particular attention to atomizing air turbulence and boundary layers. Relations between the turbulence and spray parameters and air-breathing engine performance are discussed. Author

N88-25566# United Technologies Corp., San Jose, Calif. Chemical Systems Div.
CHARACTERISTIC TIME CORRELATIONS TO LIQUID FUEL RAMJET COMBUSTION EFFICIENCY **c20**
K. E. Gallagher, G. F. Sander, and D. F. Brink *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 127-137 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21H

A combustion efficiency correlation methodology is proposed for ramjet combustors which use a combination of characteristic time and residence time distribution functions (RTDF). The intended application for this type of model is in a preliminary propulsion system design, where the effect of design and operating variables on combustion efficiency must be known to correctly optimize the component selection. The same methodology was also beneficial as a combustor data interpretation technique in which the separate interpretation of combustor, flameholder, and fuel injection performance is possible with available parametric data. This proposed approach was evaluated with four coaxial dump liquid fuel ramjet (LFRJ) test combustor databases which covered a wide range of parametric scale and operational variables. A test series was also conducted, to qualitatively validate the flameholder data interpretation technique, in which optical instrumentation was placed in the flameholder region. Author

N88-25567*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
COMBUSTION RATE LIMITS OF HYDROGEN PLUS HYDROCARBON FUEL: AIR DIFFUSION FLAMES FROM AN OPPOSED JET BURNER TECHNIQUE **c25**
Gerald L. Pellett, Rosemary Guerra, Lloyd G. Wilson, Ronald N. Reeves, and G. Burton Northam *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 139-153 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21B

Combustion of H2/hydrocarbon (HC) fuel mixtures may be considered in certain volume-limited supersonic airbreathing propulsion applications. Effects of HC addition to H2 were evaluated, using a recent argon-bathed, coaxial, tubular opposed jet burner (OJB) technique to measure the extinction limits of counterflow diffusion flames. The OJB flames were formed by a laminar jet of (N2 and/or HC)-diluted H2 mixture opposed by a similar jet of air at ambient conditions. The OJB data, derived from respective binary mixtures of H2 and methane, ethylene, or propane HCs, were used to characterize BLOWOFF and RESTORE. BLOWOFF is a sudden breaking of the dish-shaped OJB flame to a stable torus or ring shape, and RESTORE marks sudden restoration of the central flame by radial inward flame propagation. BLOWOFF is a measure of kinetically-limited flame reactivity/speed under highly stretched, but relatively ideal impingement flow conditions. RESTORE measures inward radial flame propagation rate, which is sensitive to ignition processes in the cool central core. It is concluded that relatively small molar amounts of added HC greatly reduce the reactivity characteristics of counterflow hydrogen-air diffusion flames, for ambient initial conditions. Author

N88-25568*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
MACH 2 COMBUSTION CHARACTERISTICS OF HYDROGEN/HYDROCARBON FUEL MIXTURES **c25**
Glenn S. Diskin, C. J. Jachimowski, G. Burton Northam, and Randy A. Bell (George Washington Univ., Hampton, Va.) *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 155-169 Previously announced in IAA as A88-20321 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21B

The combustion of H2/CH4 and H2/C2H4 mixtures containing 10 to 70 vol pct hydrocarbon at combustor inlet Mach number 2 and temperatures 2000 to 4000 R is investigated experimentally, applying direct-connect test hardware and techniques similar to those described by Diskin and Northam (1987) in the facilities of the NASA Langley Hypersonic Propulsion Branch. The experimental setup, procedures, and data-reduction methods are described; and the results are presented in extensive tables and graphs and characterized in detail. Fuel type and mixture are found to have little effect on the wall heating rate measured near the combustor exit, but H2/C2H4 is shown to burn much more efficiently than H2/CH4, with no pilot-off blowout equivalence ratios greater than 0.5. It is suggested that H2/hydrocarbon mixtures are feasible fuels (at least in terms of combustion efficiency) for scramjet SSTO vehicles operating at freestream Mach numbers above 4. IAA

N88-25569*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DUAL STOKES CARS MEASUREMENTS IN SUPERSONIC COMBUSTING FLOW **c34**
Olin Jarrett, Jr., Richard R. Antcliff, Tawit Chitsomboon, Glenn S. Diskin, and Andrew D. Cutler (George Washington Univ., Hampton, Va.) *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 171-178 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21B

Coherent antiStokes Raman spectroscopy (CARS) was used to make simultaneous measurements of temperature, nitrogen and oxygen density in a reacting supersonic flow. A supersonic burner (SSB) was designed to provide supersonic flow in which combustion can be studied in the laboratory. Measurements made with the CARS system will be used for validation of computational fluid dynamic (CFD) codes. Preliminary results of the CFD calculations are presented. Author

N88-25570# M L Energia, Inc., Princeton, N.J.
RECENT ADVANCES IN PHOTOCHEMICAL TECHNIQUES FOR IGNITION AND COMBUSTION ENHANCEMENT **c25**
Moshe Lavid and Arthur T. Poulos *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 179-192 (For primary document see N88-25554 19-28)
(Contract F49620-85-C-0145; Grant NSF ISI-85-21264)
Avail: NTIS HC A17/MF A01 CSCL 19A

Operation of many systems containing combustion processes is currently hindered by constraints imposed by combustion associated phenomena such as incomplete burning, slow flame propagation, pollutant emission, flammability and ignitibility limits and instability. Replenishment of reactive radicals is known to have a major role in accelerating the overall combustion reaction rate resulting in improvement in ignition and significant combustion enhancement. Recent advances in photochemical (non-intrusive) techniques for in-situ production of radicals to promote combustion are reviewed. It encompasses single and multiphoton excitations of reactants, intermediates and inhibiting species. Single photon (SP) processes in the vacuum ultraviolet (VUV) and ultraviolet (UV) regions are used to photodissociate molecular oxygen, hydroperoxyl metastable radicals, and aldehydes into reactive radicals. The effect is examined in hydrogen and hydrocarbon flames. Infrared multiphoton (IRMP) excitation is exploited to obtain ignition of alcohols. It is found that CO2 laser excitation into vibrational modes promotes vibrational ladder-climbing and very rapid dissociation into reactive radicals. Analytical modeling simulating photochemical reactions elucidates the fundamental chemical and physical processes governing ignition and combustion enhancement and provides essential guidance for the difficult and complex experimental research effort. Author

N88-25571# California Univ., Berkeley. Dept. of Mechanical Engineering.
LOW FREQUENCY PRESSURE OSCILLATIONS IN A MODEL RAMJET COMBUSTOR **c20**
K. Yu, A. Trouve, and John W. Daily *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 193-198 (For primary document see N88-25554 19-28)
(Contract N00014-84-K-0372)
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Low frequency pressure oscillations were studied in a model ramjet combustor facility. The facility has a variable geometry test section with full optical access. An experimental investigation was made of a particular case in which the geometry and operating conditions were selected to maintain a highly unstable combusting flow. A phase sensitive schlieren system was used for visualization and high sensitivity pressure transducers for time-resolved pressure measurements. The results indicate that the inlet acoustics strongly influence the low frequency mode studied. Author

N88-25572# San Diego State Univ., Calif.
THE PRESSURE FIELD GENERATED IN A COLD-FLOW SIDE-DUMP RAMJET COMBUSTOR **c20**
Gregory Hildebrand and Nagy Nosseir *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 199-208 (For primary document see N88-25554 19-28)
(Contract N00014-84-K-0373)
Avail: NTIS HC A17/MF A01 CSCL 21H

Flow-induced pressure oscillations are investigated experimentally in a full-scale, two-inlet, side-dump combustor. Pressure and velocity measurements, and wall tracers visualization are used to study the general characteristics of the flowfield, and possible mechanism(s) for the generation of dominant flow-induced pressure oscillations and their coupling with the acoustic modes of the combustor. The results of the present cold flow experiment are compared with combustion instabilities in similar ramjet combustors. Author

N88-25573# Department of the Navy, Washington, D. C. Lab. for Computational Physics and Fluid Dynamics.
EFFECTS OF MACH NUMBER ON ACOUSTIC-VORTEX INTERACTIONS IN A RAMJET **c20**
K. Kailasanath, J. H. Gardner, J. P. Boris, and E. S. Oran *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 209-218 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21H

The objective is to use numerical simulations to study the effects of changing the inflow Mach number on the acoustic-vortex interactions in an axisymmetric ramjet combustor. Three different inflow Mach numbers are considered. The Mach numbers are changed by changing the flow velocity while holding the pressure and density and hence the sound speed the same. When the flow velocity is increased, the natural instability frequencies of the shear layer increases but the acoustic frequencies remain essentially the same. Hence, this changes the coupling between the acoustics and the flow instabilities. From this series of calculations, it is concluded that the shear layer in a confined geometry such as that in a combustor rolls up at either its natural instability frequency or at a dominant acoustic frequency of the system, if that frequency is nearly equal to or greater than the natural instability frequency. In all the simulations, the acoustic frequencies affect the vortex mergings which occur within the combustor. Author

N88-25574# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
CONTROL OF COMBUSTION INSTABILITIES IN RAMJET MOTORS **c20**
U. G. Hegde, D. M. Reuter, B. R. Daniel, and B. T. Zinn *In*

Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 219-228 (For primary document see N88-25554 19-28)
(Contract N00014-84-K-0470)
Avail: NTIS HC A17/MF A01 CSCL 21H

The control of longitudinal combustion instabilities in dump type ramjet engines is a problem of considerable practical importance. It is shown that the geometry of the flame in the combustion chamber can strongly influence both the level as well as the frequency of the observed instabilities and thus serve as a means for their control. Results obtained for different flame shapes, realized by relatively displacing two flame holders in the combustion chamber, are described. The important mechanism governing the instabilities is found to be a periodic merging of the flame fronts from the two flame holders. This results in periodic changes in the flame surface area and leads to unsteady heat release rates at the merging frequency which, in turn, drive the acoustic oscillations. By adjusting the relative displacements of the flame holders, the merging of the flame fronts can be manipulated and the instability controlled. Author

N88-25575# Naval Postgraduate School, Monterey, Calif.
IGNITION AND FLAMMABILITY CHARACTERISTICS OF SOLID FUEL RAMJETS **c20**
R. C. Wooldridge, A. Karadimitris, and D. W. Netzer *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 229-238 (For primary document see N88-25554 19-28)
(Proj. N6053087WR30009)
Avail: NTIS HC A17/MF A01 CSCL 21H

An experimental investigation was conducted to study the effects of inlet step height on ignition and flammability limits and recirculation zone and boundary layer combustion phenomena of various metallized and nonmetallized fuels. A windowed, variable inlet geometry, two-dimensional solid fuel ramjet (SFRJ) was utilized. High speed motion pictures of the interior of the combustion chamber at the recirculation zone and the boundary layer development region were obtained. Data were obtained at a mass flux of 0.2 lbm/sq in-sec at a nominal air inlet temperature of 1000 R, with pressures ranging from 100 to 150 psi. The flammability limits for nonmetallized fuels were found to be approximately the same or slightly less in step height than the ignition limits. Recirculation zone flame stability was dominant in determining flammability for these fuels. Small steps in the fuel surface were found to significantly reduce the inlet step requirements for flame stability. Author

N88-25576*# Aerojet TechSystems Co., Sacramento, Calif.
DEVELOPMENT OF A GENERIC COMBUSTION STABILITY CODE FOR LIQUID PROPELLANT ROCKET ENGINES **c20**
J. J. Fang and Y. T. Jones *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 239-257 (For primary document see N88-25554 19-28)
(Contract NAS8-36274)
Avail: NTIS HC A17/MF A01 CSCL 21H

The mathematical framework for a combustion stability analysis code is outlined. The goal for the code is to be general enough in problem treatment so that its validity and accuracy extend over a wide range of problem applications and that it lends the convenience for any future model improvement if necessary. An approach for modeling the combustion dynamics is devised to meet both requirements. An open-loop numerical procedure is also developed to mechanistically model various combustion processes for determining the stability parameters. Author

N88-25577*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NUMERICAL GRID GENERATION AND FLOW SIMULATION IN SSME THRUST CHAMBER **c20**
K. W. Gross, P. L. Daley, and A. J. Przekwas (CHAM of North America, Inc., Huntsville, Ala.) *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 259-266 (For primary document see N88-25554 19-28)
(Contract NAS8-36552)
Avail: NTIS HC A17/MF A01 CSCL 21H

The development of liquid and solid rocket engines for future space projects demands a detailed optimization process for highly efficient performance and cost reasons. Also, testing of full size engines may not be feasible when the large size requires test facilities which are cost prohibitive or if vacuum operation cannot be acquired. For such situations only scaling from small test scale measurements or accurate analytical predictions will provide the performance prior to actually flying the mission. A rigorous approach for simulating the combustion processes in liquid rocket engines by employing a direct solution of Navier-Stokes equations within the entire volume of the thrust chambers is presented. This method is illustrated in the solution of reactive flow in the Space Shuttle Main Engine (SSME) thrust chamber. The objective is to review recent improvements in the mathematical model and to present the grid generation methodology suitable for rocket thrust chamber geometries. Author

N88-25578# Illinois Univ., Chicago. Dept. of Mechanical Engineering.
ANATOMY OF GROUP BURNING MODE TRANSITIONS IN SPRAY GROUP COMBUSTION **c25**
S. A. Lottes and H. H. Chiu *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 267-276 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21B

A steady spray group combustion computer code was extended to do unsteady computations. First uses of the extended code were to identify process and combustion structures in the group combustion mode transitions from sparse spray to dense spray. A gray scale graphics printing program was also developed to process the large volume of output data from the spray code and to display the results in a vivid and compact form. Results indicate that characteristic group combustion modes form on the time scale of chamber residence time. The processes of mode formation are also revealed to be primarily the results of droplet response to chamber conditions and to convection effects. Author

N88-25579# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
FUEL DROPLET VAPORIZATION AND TEMPERATURE DISTRIBUTIONS OF AXISYMMETRIC UNSTEADY SPRAYS
S. K. Lee and T. J. Chung *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 277-290 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 19A

Droplet vaporization and temperature distributions of axisymmetric unsteady sprays were discussed. The so-called discrete droplet model of two-phase flows, often known as the Eulerian-Lagrangian method, is used. Calculations are carried out using the finite element method for the gas phase with Eulerian coordinates and the method of characteristics for the liquid phase with Lagrangian coordinates. The sensitivity of the numerical results to changes in time step, injection pulse time, grid spacing, and number of droplet characteristics is examined. It is shown that the grid spacing affects the accuracy more than does the number of characteristics used. Furthermore, the multivaluedness of physical droplet properties can be handled satisfactorily with the Eulerian-Lagrangian formulation via finite elements for the gas phase and the second order Runge-Kutta scheme for the liquid phase. Author

N88-25580*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A DETAILED DESCRIPTION OF THE UNCERTAINTY ANALYSIS FOR HIGH AREA RATIO ROCKET NOZZLE TESTS AT THE NASA LEWIS RESEARCH CENTER **c20**
Kenneth J. Davidian, Ronald H. Dieck (Pratt and Whitney Aircraft, West Palm Beach, Fla.), and Isaac Chuang *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct.

1987 p 291-318 Previously announced as N87-28602 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21H

A preliminary uncertainty analysis was performed for the High Area Ratio Rocket Nozzle test program which took place at the altitude test capsule of the Rocket Engine Test Facility at the NASA Lewis Research Center. Results from the study establish the uncertainty of measured and calculated parameters required for the calculation of rocket engine specific impulse. A generalized description of the uncertainty methodology used is provided. Specific equations and a detailed description of the analysis is presented. Verification of the uncertainty analysis model was performed by comparison with results from the experimental program's data reduction code. Final results include an uncertainty for specific impulse of 1.30 percent. The largest contributors to this uncertainty were calibration errors from the test capsule pressure and thrust measurement devices. Author

N88-25581*# Software and Engineering Associates, Inc., Carson City, Nev.
A COMPUTER PROGRAM FOR PERFORMANCE PREDICTION OF TRIPROPELLANT ROCKET ENGINES WITH TANGENTIAL SLOT INJECTION **c20**
Anthony Dang and Gary R. Nickerson *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 319-327 (For primary document see N88-25554 19-28)
(Contract NAS8-36863)
Avail: NTIS HC A17/MF A01 CSCL 19A

For the development of a Heavy Lift Launch Vehicle (HLLV) several engines with different operating cycles and using LOX/Hydrocarbon propellants are presently being examined. Some concepts utilize hydrogen for thrust chamber wall cooling followed by a gas generator turbine drive cycle with subsequent dumping of H2/O2 combustion products into the nozzle downstream of the throat. In the Space Transportation Booster Engine (STBE) selection process the specific impulse will be one of the optimization criteria; however, the current performance prediction programs do not have the capability to include a third propellant in this process, nor to account for the effect of dumping the gas-generator product tangentially inside the nozzle. The purpose is to describe a computer program for accurately predicting the performance of such an engine. The code consists of two modules; one for the inviscid performance, and the other for the viscous loss. For the first module, the two-dimensional kinetics program (TDK) was modified to account for tripropellant chemistry, and for the effect of tangential slot injection. For the viscous loss, the Mass Addition Boundary Layer program (MABL) was modified to include the effects of the boundary layer-shear layer interaction, and tripropellant chemistry. Calculations were made for a real engine and compared with available data. Author

N88-25582*# Remtech, Inc., Huntsville, Ala.
BOUNDARY LAYER SIMULATOR (BLIMPJ) IMPROVEMENT **c34**
S. C. Praharaj and C. P. Schmitz *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 329-338 (For primary document see N88-25554 19-28)
(Contract NAS8-36551)
Avail: NTIS HC A17/MF A01 CSCL 20D

Improvements were made to advance the current Boundary Layer Integral Matrix Procedure - Version J (BLIMPJ) containing previously modeled simplified calculation methods accounting for surface roughness, relaminarization, and thick boundary layer effects. These improvements have potential applications in the design of the future Orbit Transfer Vehicles (OTV) engines. The coded wall roughness module was validated successfully against measured data from the LeRC 60-15 degree half-angle conical nozzle. The relaminarization model was modified to include wall cooling and roughness based on a set of test data from the same nozzle. The model was compared against typical data sets for validation in different flow regimes. The thrust loss calculation for thick boundary layer effects was computerized where the iterations between TDK and BLIMPJ proceeded automatically until convergence was achieved. An example is given for a typical OTV nozzle with an area ratio 1293. Author

N88-25583# Army Armament Research, Development and Engineering Center, Picatinny Arsenal, N.J.
PRESSURE/TEMPERATURE SENSITIVE INORGANIC PHOSPHORS
William O. Seals, Henry W. Offen, W. Dale Turlev, and Henry M. Borella (Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.) *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 339-349 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 19A

In the vulnerability assessment of liquid propellants a problem occurred in monitoring the hydraulic pressures produced within the liquid propellant when impacted by a shaped charge. Kistler gauges were initially used to measure the pressures generated. However, the pressures experienced in a one-gallon container of liquid propellant under shock loading exceeded the measuring ability of the Kistler gauges. These pressures were in excess of 100,000 psi. Normally, liquid propellant will be stored in larger quantities. It is critical to know the pressures generated in large stored quantities of liquid propellant to determine safety design criteria for stored containers. Another concern is the safety of the crew members in an Army vehicle from the high hydraulic pressures produced when a liquid propellant is shock loaded. A program was initiated to ascertain the feasibility of using pressure and temperature-sensitive inorganic phosphors to remotely monitor these parameters. This effort is discussed. Author

N88-25584*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LIQUID ENGINE JET ATOMIZATION WORKSHOP REPORT **c20**
Klaus W. Gross *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 351-353 Workshop held in Huntsville, Ala., 16-17 Sep. 1987 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21H

The workshop was oriented to disclose information and unsettled problems to understand the fundamental physical mechanism of the droplet formation process. Based on presentation and discussion of results, recommendations were made which should lead to associated future activities. To accomplish this task, existing observations and experiments, contributing to the basic knowledge, providing data for analytical concept verification, and forming a basis for empirical correlations were solicited. Advanced analytical modeling methods or results from specific studies were requested as well as the experience and advice from injector designers. All effort is directed to advance current analytical techniques, simulating the flow behavior downstream of the injection elements in a liquid rocket combustion chamber. Such a tool can be used to optimize injector designs with respect to short length weight savings, wall material protection, or large heat energy transport to a regenerative cooling fluid, while simultaneously achieving the maximum specific impulse in performance. The liquid atomization process also forms a sound basis for combustion instability analysis. Author

N88-25585# Johns Hopkins Univ., Laurel, Md. Chemical Propulsion Information Agency.
THE 24TH JANNAF COMBUSTION MEETING, VOLUME 1
Dorothy L. Becker, ed. Oct. 1987 430 p Meeting held in Monterey, Calif., 5-9 Oct. 1987
(Contract N00039-87-C-5301)
(AD-A190163; CPIA-Publ-476-Vol-1) Avail: NTIS HC A19/MF A01

Specific subjects discussed include combustion stability; ignition; burn rate; flame structure; particle size measurement of solid rocket propellants; and the ignition, chemistry, and thermal degradation of nitramine propellants. For individual titles, see N88-25586 through N88-25618.

N88-25586# Brigham Young Univ., Provo, Utah.
EVIDENCES FOR DISTRIBUTED COMBUSTION
M. W. Beckstead *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 1-12 (For primary document see N88-25585 19-28)
(Grant AF-AFOSR-0157-83)
Avail: NTIS HC A19/MF A01 CSCL 19A

Distributed combustion refers to a burning particle which reacts far from the burning surface, exchanging energy with an acoustic environment. This process of distributed combustion was generally ignored in acoustic analyses of rocket motors in the past. It is normally assumed that a particle additive (usually aluminum) burns close enough to the propellant surface to be treated as a boundary condition. A number of examples of experimental data, general observations, and theoretical calculations are presented which provide evidence that burning particles can and do burn far from the propellant surface and can have a strong interaction with the acoustics of a system. None of the examples are completely quantitative. In consideration of the several examples together, the evidence seems to indicate that distributed combustion is a significant effect that should not be neglected. Author

N88-25587# Brigham Young Univ., Provo, Utah.
CHARACTERIZATION OF A MODIFIED RIJKE BURNER FOR MEASUREMENT OF DISTRIBUTED COMBUSTION
J. C. Finlinson, M. A. Nelson, and M. W. Beckstead *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 13-25 (For primary document see N88-25585 19-28)
(Grant AF-AFSOR-0157-83)
Avail: NTIS HC A19/MF A01 CSCL 19A

The progress of a continuing study of distributed combustion is covered using a modified Rijke burner. The closed-open Rijke burner designed by Braithmaite and Gordon used a paddle on the open end of the burner to change the acoustic boundary conditions and reduce the oscillations. To eliminate particle and gas flow disruption, as well as to allow independent damping of the thermoacoustic oscillations, their apparatus was modified by locating a butterfly valve at the closed end of the cold section. The characterization of the current burner is described. The acoustic growth rate, alpha, of the burner was characterized experimentally as a function of frequency, flame position, length, inlet gas compositions (O2, N2, C3H8), and energy balance. The modified Rijke burner allows for measurement of the acoustic growth rate from a non-oscillating to a strongly oscillating environment. The data indicated that the overall acoustic driving forces in a Rijke burner are dependent upon the acoustic mode shape relative to the distribution of energy, which is a function of the gas flow rates and heat losses. Author

N88-25588# Brigham Young Univ., Provo, Utah.
NONLINEAR MECHANISMS OF SOLID PROPELLANT COMBUSTION INSTABILITY
M. W. Beckstead *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 27-40 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 19A

T-burner data are examined with the objective of identifying the physical mechanisms that relate to the nonlinear behavior of the propellant/T-burner system. A quantitative measure of the system nonlinearities is obtained by dividing the linear growth constant (which is the basic data normally obtained from T-burners) by the limiting oscillatory pressure amplitude reached during a firing. This quantity was calculated and examined for a variety of composite and double-base propellant tests, which were reported in the literature, wherein test conditions were varied over a range of pressures, frequencies, and burner diameters. Effects of pressure and frequencies are also discussed. The results indicate that a dominant nonlinear physical mechanism is related to particles. Propellants with particles (i.e., metallized) always show higher nonlinearities than nonmetallized propellants, up to a full order of magnitude greater. Tests performed in a velocity coupling configuration with metallized propellants also show an increase in the measured nonlinearities. Author

N88-25589*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROPELLANT COMBUSTION RESPONSE TO OSCILLATORY RADIANT HEAT FLUX
L. D. Strand, K. Schwartz, and S. P. Burns *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 41-49 Sponsored by NASA, Washington, D. C. (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 21I

An introductory progress report is given on a research project to use the microwave Doppler velocimeter technique to measure the combustion response to an oscillating thermal radiation source (laser). The objective is to relate the measured burning rate response to the thermal radiation to an equivalent oscillation in pressure using existing thermal combustion theory. The test system is described, and the results of an initial test series on the composite propellant A-13 are presented. Author

N88-25590# Sandia National Labs., Albuquerque, N. Mex. Combustion Research Facility.
DYNAMICS OF PROPELLANT IGNITION
M. L. Koszykowski, Robert C. Armstrong, and C. F. Melius *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 51-60 Sponsored in part by Department of the Army, Washington, D.C. and DOE, Washington, D.C. (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 19A

Time dependent processes of solid propellant deflagration are modeled and a numerical simulation of ignition, extinguishment, and reignition is presented. Combustion is induced by the application of energy to the moving gas/solid interface until steady conditions are achieved. Extinction can be induced by suddenly terminating this energy source (a process often referred to a deradiative extinction). An activation energy asymptotic theory for deradiation was previously developed for a Denison and Baum-type model. It was predicted that an influx of radiation on the order steady heat release of the exothermic reaction will extinguish the propellant. It was demonstrated that the inclusion of low activation energy radical reactions and gas phase attack on the solid by radicals can reverse this result, and, after a short pause subsequent to the deradiation event, the propellant will reignite and freely burn with no external energy source. The reason for this behavior lies in the inventory of radicals acquired between the gas/solid surface and the end of the gas combustion zone during the period of radiative heating. These radicals contain a considerable amount of chemical energy as well as the ability to participate in chain propagating reactions at the considerably lower temperatures reached after the deradiation even. These factors allow the propellant to recover from the extinguishment. Author

N88-25591# Sandia National Labs., Albuquerque, N. Mex. Combustion Research Facility.
NEW INSTABILITY PHENOMENA IN SOLID PROPELLANT COMBUSTION
Stephen B. Margolis and Forman A. Williams (Princeton Univ., N. J.) *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 61-68 Sponsored in part by DOE, Washington, D.C. and the Department of the Army, Washington, D.C. (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 19A

Intrinsic instability in the steady, planar deflagration of a homogeneous solid propellant is considered through an asymptotic analysis for large values of nondimensional overall activation energies for the surface pyrolysis and gas-phase combustion processes. It is shown that the previously known pulsating instability is essentially connected with condensed-phase pyrolysis and that the instability phenomena, which are associated with intrinsic gas-flame instability and which are sensitive to the value of the gas-phase Lewis number and to the distance of the gas flame from the propellant surface, arise. These results are obtained by

relaxing the usual assumption of quasi-steadiness and quasi-planarity for the gas phase, so that the coupling of intrinsic diffusional/thermal instabilities in the gas and solid phases becomes an integral feature. The steady, planar deflagration thus may be unstable not only to pulsating disturbances, but also to cellular perturbations as well. It is shown that the onset of pulsating instability has a dual character which is related to the intrinsic instabilities of both the deflagrating solid and the gas flame. In contrast, the onset of cellular instability, apparently not predicted by previous theories for solid propellants, is clearly related to the stability of the gas flame. Appropriate limiting cases of the model retrieve the well-known pulsating and cellular neutral stability boundaries for strictly gaseous combustion, and the pulsating neutral stability boundary for strictly condensed phase combustion. Author

N88-25592# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.

DRIVING OF AXIAL ACOUSTIC FIELDS BY SIDE-WALL STABILIZED PREMIXED FLAMES

S. V. Sankar, J. I. Jagoda, B. R. Daniel, and B. T. Zinn *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 69-78 (For primary document see N88-25585 19-28)

(Grant AF-AFOSR-0082-84)

Avail: NTIS HC A19/MF A01 CSCL 19A

To develop an understanding of the driving of axial instabilities in solid propellant rocket motors, the driving of axial acoustic fields by a laminar, premixed, flat flame, stabilized on the porous side-wall of a rectangular duct was studied both theoretically and experimentally. It is shown that the investigated flame responds to the presence of an axial acoustic field by producing an oscillatory normal velocity, v prime, which can drive or damp the acoustic field. The measurement of this normal velocity distribution under different oscillatory flow conditions is described. Comparison of the measured data with theoretical predictions reveal satisfactory agreement between the two. These studies show that while certain regions of the flame zone tend to drive the acoustic field, other regions of the flame damp the acoustic oscillations. The net effect of the flame upon the acoustic field depends upon the relative magnitudes of these opposing tendencies. It is also shown that the flame driving depends upon the acoustic admittance of the side-wall surface and the acoustic frequency. Author

N88-25593# Naval Research Lab., Washington, D.C. Lab. for Computational Physics and Fluid Dynamics.

NUMERICAL INVESTIGATION OF ACOUSTIC ENERGY EXCHANGE THROUGH FLOW TURNING **c20**

Joseph D. Baum *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 79-100 (For primary document see N88-25585 19-28)

(Contract MIPR-87-0040)

Avail: NTIS HC A19/MF A01 CSCL 21H

The objective is to understand the physical mechanisms by which energy is exchanged between the mean and acoustic flow in the very near wall zone in resonant combustion chambers. Results obtained in the study of acoustic refraction, flow turning, and acoustic streaming phenomena (processes which may significantly alter the balance between sources and sinks of oscillatory energy) are described and analyzed. The time-dependent compressible Navier-Stokes equations were solved utilizing an implicit, non-iterative linearized block implicit scheme. Two test cases were investigated: acoustic wave propagation in a tube with a coexisting shear mean flow (refraction test) and acoustic wave propagation in a tube where the mean sheared flow was injected into the tube through its lateral boundary (flow turning). Acoustic streaming effects were observed for both tests. For flow turning, significant excitation of mean flow energy was observed at two locations: the edge of the acoustic boundary layer, and within a zone adjacent to the acoustic boundary layer extending up to 0.1 radii away from the wall. A weaker streaming effect was observed for the refraction study only at the edge of the acoustic boundary layer. The total dissipation for the flow turning test was twice the dissipation for the refraction. Vorticity was produced inside the acoustic boundary layer for both the maxima and minima of the wave. Finally, perturbation energy was diminished in amplitude as the wave traversed the length of the tube, with higher dissipation for the flow turning test. Author

N88-25594# Naval Weapons Center, China Lake, Calif. Research Dept.

MOTOR TEST DATA COMPARISONS WITH LABORATORY DATA AND STABILITY PREDICTIONS **c20**

J. E. Crump, H. B. Mathes, W. H. Clark, and M. W. Beckstead (Brigham Young Univ., Provo, Utah.) *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 101-114 (For primary document see N88-25585 19-28)

Avail: NTIS HC A19/MF A01 CSCL 21H

A coordinated effort was initiated to improve understanding of linear and nonlinear combustion stability in solid propellant rocket engines, and develop a systematic data base of motor and stability data. The pressure coupled response of a typical reduced smoke propellant was measured at 500 and 1000 psia. The results show significantly higher values of response function for the 500 psi cases over th lower frequency range (0 to 1200 Hz). The steady state predictions using Standard Stability Program (SSP) show a significant sensitivity to input burning rate and to the values used for erosive burning parameters. Motor stability calculations show that the stability margin of the motor decrease with time, but all of the configurations should be linearly stable for the entire firing. Additional testing during this coming year should add additional understanding to the state of knowledge of combustion stability. B.G.

N88-25595# Atlantic Research Corp., Alexandria, Va.

ONE PERSON'S VIEW OF VELOCITY-COUPLED INSTABILITY **c20**

Merrill K. King *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 115-130 (For primary document see N88-25585 19-28)

Avail: NTIS HC A19/MF A01 CSCL 21H

Oscillations in lateral flow across a solid propellant surface often result in corresponding oscillations (shifted in phase and magnitude) of the burning rate of the propellant and sometimes also cause a shift in the mean burn rate. If a component of the resulting oscillations in radial pressure oscillations at the location of interest, positive or negative (depending on the phase angle) contributions to chamber acoustic energy will result, leading to increased or decreased tendency for the motor to exhibit unstable combustion. At this date, velocity-coupling phenomena are not particularly well understood. However, it has become clear the velocity-coupled admittance cannot be treated as an intrinsic propellant function highly-two-dimensional flow field associated with centrally-perforated grain bores. The author's views of the current state of knowledge and of major gaps in understanding, modeling, and experimental characterization of velocity-coupling phenomena are presented. Author

N88-25596# Air Force Astronautics Lab., Edwards AFB, Calif.

VELOCITY COUPLING **c20**

Gary L. Vogt *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 131-139 (For primary document see N88-25585 19-28)

Avail: NTIS HC A19/MF A01 CSCL 21H

A velocity coupling workshop was held on July 1, 1987 in San Diego, Calif., and results were presented of current and past efforts to determine physical mechanisms through which periodic instabilities in a solid rocket motor are coupled to the combustion response of solid propellant. It is believed that instabilities (flow induced oscillations, acoustic oscillations, combustion generated noise) in the combusiton chamber are coupled to the burning propellant's surface and influences the combustion response of propellant in a manner not related to the pressure coupled response of propellant. Author

N88-25597# FMC Corp., Minneapolis, Minn.
A REVIEW OF PARTICLE SIZING METHODS IN ROCKET PROPULSION
J. H. Koo *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 141-156 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 19A

A study was conducted to review particle sizing methods that are applied in the field of rocket propulsion. The different types of methods that were used in obtaining particle size distributions and particle velocity in rocket exhaust plumes for the last two decade. Restrictions and merits of the various techniques are identified. The principles governing each technique are discussed. Author

N88-25598# Illinois Univ., Urbana.
SELECTIVE RADIATION ABSORPTION IN ALUMINIZED COMPOSITE PROPELLANT COMBUSTION
M. Q. Brewster and B. E. Hardt *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 157-163 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 19A

The optical properties of aluminized AP composite propellants, including Fe2O3 are described. The correlation between spectral absorptivity and propellant composition is investigated. The possibility of selective aluminum heating due to absorption of radiation by aluminum is discussed. A possible link between optical properties and catalytic behavior of transition metal oxides in aluminized AP composite propellants is suggested. Author

N88-25599# Naval Postgraduate School, Monterey, Calif.
MEASUREMENT OF PARTICULATE SIZE IN SOLID PROPELLANT ROCKET MOTORS
S. Orguc, T. E. Pruitt, T. D. Edwards, E. D. Youngborg, J. P. Powers, and D. W. Metzer *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 165-182 (For primary document see N88-25585 19-28)
(Contract F00464-87-X-0040)
Avail: NTIS HC A19/MF A01 CSCL 19A

Small, windowed solid propellant rocket motors were used to measure the particulate sizes produced by the combustion process. Both measurements of diffractively scattered light and holography were used in the motor cavity and the former was also used in the nozzle exhaust. Automatic data retrieval of particle size data from the reconstructed holograms was also accomplished. Progress on the particle sizing techniques and data retrieval are presented. Author

N88-25600# Stanford Univ., Calif.
INSTANTANEOUS TWO-DIMENSIONAL MULTIPLE PARTICLE SIZING DIAGNOSTIC
D. I. Hofeldt, M. G. Allen, and R. K. Hanson *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 183-192 Sponsored in part by NSF, Washington, D.C. (For primary document see N88-25585 19-28)
(Contract N00014-84-K-0383)
Avail: NTIS HC A19/MF A01 CSCL 19A

A method for instantaneously measuring the spatial distribution and size of all particles in a plane is presented. The method is applicable to spherical particles larger than about 10 microns (0.39 mil) located in particle flow regimes with number densities less than or on the order of 500 to 1000 per cu cm (8200 to 16400 per cubic inch). The accuracy and sizing range depends on characteristics of the illuminating sheet and the digital cameras employed, are discussed. Initial experiments to validate the techniques are also presented. Author

N88-25601*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE SCALING OF THE THRESHOLD CONDITIONS FOR SOLID PROPELLANT EROSIVE BURNING
L. D. Strand, M. Nguyen, and N. S. Cohen (Cohen, Norman S. Professional Services, Inc., Redlands, Calif) *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 193-200 Sponsored by NASA, Washington, D.C. (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 21H

The effects of the parameters that are considered to influence most strongly the scaling to larger rocket motor sizes of the transition or threshold conditions for erosive burning rate augmentation are measured and a scaling criterion for the threshold conditions for erosive burning is developed. The results are presented for a series of motor firings that were performed to measure the transition length threshold conditions (axial position at which deviation from nonerosive burning rate begins) while attempting to systematically vary the parameters that are considered to control the phenomena. The results of attempts to correlate the threshold conditions with several flow parameters are presented. Author

N88-25602# Sandia National Labs., Albuquerque, N. Mex. Combustion Research Facility.
EFFECT OF BURN-PATH TORTUOSITY ON THE BURN RATE OF COMPOSITE PROPELLANTS
Alan R. Kerstein *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 201-204 Sponsored by DOE, Washington, D.C. (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 19A

The composition dependence of the burn rate of polydisperse composite solid propellants is predicted by analyzing the least-time path of the burn front through the propellant. The predicted burn rate is the average burn rate along the least-time path divided by the tortuosity, or arc length per streamwise interval, of the least-time path. The tortuosity analysis is based on percolation theory. This model and an alternative formulation which omits tortuosity considered are used to correlate measured burn rates for a suite of polydisperse ammonium perchlorate composites. Inclusion of tortuosity is found to improve the performance of the model significantly. Author

N88-25603# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
DIMENSIONAL ANALYSIS AND EXPERIMENTAL OBSERVATION OF THE COUPLING PHENOMENA BETWEEN COMBUSTION AND FRACTURE OF DAMAGED PROPELLANT SAMPLES
Jir-Ming Char, Jesse Smedley, Jeffrey Nimis, and Kenneth K. Kuo *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 205-216 (For primary document see N88-25585 19-28)
(Contract N00014-79-C-0762)
Avail: NTIS HC A19/MF A01 CSCL 19A

The importance of crack combustion in solid rocket motors is widely recognized. However, the processes of crack propagtion and branching in burning solid propellants are not as yet well understood. These processes could be instrumental in creating large specific-surface areas for burning, and could cause rocket motor failure. Numerous propellant samples were recovered from interrupted-burning experiments. Depending on the pressurization rate and sample geometry, different modes of crack propagation and/or branching were observed. This problem was analyzed through the use of basic physical principles, experimental results, and Schapery's theory of crack propagation. A set of governing dimensionless parameters which control and characterize the degree of damage was obtained. Key factors influencing the crack combustion, propagation, and branching process considered in the dimensional analysis include chamber pressurization rate, stress intensity factor, fracture toughness, initial crack length, initial temperature, propellant sample geometry, and mechanical and thermal properties of the solid propellant. Based on the experimental results, a multiple regression analysis was performed to obtain a set of correlations between the dimensionless parameters. The procedures developed demonstrate a methodology for obtaining similar correlations which could be used

as guidelines for establishing sage operating conditions of rocket motors. Author

N88-25604# Air Force Astronautics Lab., Edwards AFB, Calif.
ANALYSIS OF MICROWAVE BURNER MEASUREMENT SYSTEM USING A MICROWAVE NETWORK ANALYSIS COMPUTER PROGRAM **c25**
Gary L. Vogt *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 217-233 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 21B

The principle assumption when using a microwave signal to measure the movement of a surface is that the rate of change of position may be determined from the Doppler shift between the transmitted and reflected signals. When used for the measurement of the regression rate of solid propellant and reflected signals. When used for the measurement of the regression rate of solid propellant which behaves as a variable impedance nonlinear visco-elastic material, the Doppler shift is affected by the changing conditions within the waveguide and the material whose movement is being measured. The varying conditions within a waveguide due to imposed impedance changes, and the net effect on the transmitted and reflected signals are examined. A microwave network analysis computer program is used to simulate burning propellant and to evaluate the effect of the changing conditions within the network on the perceived burn rate of the propellant. The program demonstrates that the varying conditions within the microwave waveguide affect the microwave signal strength and the manner in which the microwave signal is reflected. As a result of these changing conditions, an input constant burn rate is perceived as having anomalies that are not otherwise explained. A microwave network consisting of a source, a transition from rectangular to round waveguide, and a varying load representative of burning solid propellant were analyzed. Author

N88-25605# Air Force Astronautics Lab., Edwards AFB, Calif.
MODELING AND EXPERIMENTAL MEASUREMENTS OF SOLID PROPELLANT FLAME STRUCTURE **c25**
T. Edwards *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 235-242 Sponsored by AFOSR, Bolling AFB, Washington, D.C. (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 21B

The current status of flame kinetic modeling is compared to the current status of detailed flame diagnostic measurements. For double-base propellants, detailed mechanisms were constructed but the necessary experimental verification of the fizz zone species and thus the initial solid degradation mechanism(s) is lacking. For HMX propellants, the HMX monopropellant decomposition pathway was proposed, but the binder decomposition and the interaction between propellant flames are rare and hard to interpret. Detailed modeling of AP composite propellant flames was not attempted and will be very difficult because of the heterogeneous and time-dependent nature of the AP composite propellant flames at higher pressure. Author

N88-25606# Hercules Research Center, Wilmington, Del.
PRESSURE DIFFERENTIAL SCANNING CALORIMETRY (DSC) EVALUATION OF SOLID ROCKET PROPELLANT BURN RATE MOD
Thomas E. Casti *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 243-252 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 19A

Burn rate modifiers for solid rocket propellants are typically characterized by expensive and time consuming propellant burn rate testing. Pressure differential scanning calorimetry (DSC) methods that can rapidly identify burn rate modifiers for ammonium perchlorate (AP) and ammonium nitrate (AN) oxidized propellant formulations were developed. The method is based on the studies of the thermal decomposition of oxidizers in the presence of known burn rate modifiers. The advantage of the DSC method is that it can be used to evaluate materials that are not available in large quantities; as little as 10 mg of sample is required. Maximum heat flow rates and/or decomposition temperatures of oxidizer/burn rate modifier mixtures correlate with burn rate modifier activity in propellant mixes. Transition metal oxides (TMOs) decrease AP decomposition temperatures; this is expected to lead to higher burning rates. Catocene is distinguished from less active burn rate modifiers by the presence of a sharp exothermic peak believed to be due to rapid, exothermic oxidation of Catocene by AP. Ammonium dichromate and copper chromite significantly decrease AN decomposition temperatures; as in AP systems, this effect is believed to be responsible for higher propellant burn rates. Further experiments are being performed to develop a better understanding of how DSC can be used to predict burn rate modifier behavior in AN systems. Author

N88-25607# Morton Thiokol, Brigham City, Utah. Advanced Technology Div.
SOLID ROCKET MOTOR PERFORMANCE: A WORKSHOP REPORT **c20**
Mark Salita *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 253-276 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 21H

Topics addressed included: equilibrium thermochemistry of high-solids propellants; effect of unreacted carbon on motor performance; improved HPC 3D grain design/ballistics module; advanced 3D grain recession codes for anomaly studies; unexpected Al2O3 particle size measured in a rocket plume; a user's view of SPP: accuracy and problem areas; improved boundary layer loss calculation; improvements to SPP represented by version 6.0; scaling the threshold conditions for erosive burning; flow visualization in submerged-nozzle cavities; and multi-dimensonal modeling of motor internal flowfields. B.G.

N88-25608# Vermont Univ., Burlington.
HOW MUCH DO EDGES AFFECT THE IGNITION OF A HOMOGENEOUS REACTIVE SOLID: SUMMARY TO DATE
C. E. Hermance and L. G. Vorsteveld *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 277-280 (For primary document see N88-25585 19-28)
(Contract DAAG29-85-K-0216)
Avail: NTIS HC A19/MF A01 CSCL 21H

Approximate formulas for use in estimating the ignition delay of cylinders of a reactive solid, or sharp edges or corners of several included angles of a reactive solid, exposed to a constant heating flux at the surfaces are presented. Where possible, these formulas are compared to results obtained from integrating the governing partial differential equation. Now unsurprisingly, the sharper the edge or the smaller the cylinder, the more rapid the ignition, with a reduction in ignition delay by an order of magnitude or more compared to the one-dimensional case. Author

N88-25609# Atlantic Research Corp., Gainesville, Va.
EVALUATION OF TECHNIQUES FOR DIRECT MEASUREMENT OF BURNING RATES IN NOZZLELESS MOTORS
R. H. Woodward Waesche and W. F. OBrien (Virginia Polytechnic Inst. and State Univ., Blacksburg.) *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 281-292 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 19A

Accurate knowledge of local propellant burning rates is especially important in nozzleless motors because of large variations in port pressures and erosive burning effects. A study was conducted using the Nozzleless Performance Program (NPP) computer program to determine the resolution and accuracy requirements for non-intrusive burning-rate-measurement systems suitable for use with nozzleless motors. X-ray, microwave, and ultrasonic systems were considered. Burning-rate measurement accuracies in the range of + or - 1 percent were found to be desirable, while measurements having + or - 10 percent accuracy were found to be useful for some requirements. All three systems studied have potential application to tests of nozzleless motors. Author

N88-25610# Aerospace Corp., Los Angeles, Calif.
MINIMUM IGNITION ENERGY MEASUREMENTS USING LASER INDUCED SPARK INITIATION
J. A. Syage, R. Rianda, E. W. Fournier, and R. B. Cohen *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 293-302 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 19A

Measurements of low energy ignition of combustable mixtures is reported using ns and ps laser induced breakdown. Ignition studies are presented for homogeneous H2/air, hexane/air, and unsymmetrical dimethyl hydrazine/air mixtures. The extent of flame inhibition in H2/air was investigated as a function of CO2 concentration. The electrodeless spark ignition results are compared with earlier work using electric discharge ignition. A simple model for flame initiation is advanced based on the temporal and energy density characteristics of the source energy. Author

N88-25611# Air Force Astronautics Lab., Edwards AFB, Calif.
DEUTERIUM ISOTOPE EFFECTS IN THE COMBUSTION OF FORMULATED NITRAMINE PROPELLANTS
Paul C. Trulove, Robert D. Chapman, and Scott A. Shackelford *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 303-308 Sponsored in part by AFOSR, Bolling AFB, Washington, D.C. (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 19A

The deuterium isotope effect was used to investigate the rate limiting reactions in the combustion of nitramine propellants. Model propellant formulations containing HMX, RDX, and their deutrated analogs were pressed into pellets and burned under nitrogen pressure in a window bomb. The magnitudes of the observed deuterium isotope effects suggest the HMX and RDX ingredients exert significant control over the burn mechanisms of the studied nitramine propellants, and that rupture of the C-H bond in these ingredients is the rate-controlling molecular process in combustion. Author

N88-25612# Sandia National Labs., Albuquerque, N. Mex. Combustion Research Facility.
SIMULTANEOUS THERMOGRAVIMETRIC MODULATED BEAM MASS SPECTROMETRY AND TIME-OF-FLIGHT VELOCITY SPECTRA MEASUREMENTS: THERMAL DECOMPOSITION MECHANISMS OF RDX AND HMX
Richard Behrens, Jr. *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 333-342 Sponsored in part by the Department of the Army, Washington, D.C. and DOE, Washington, D.C. (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 19A

Time-of-flight (TOF) velocity spectra, simultaneous thermogravimetric modulated beam mass spectrometry (STMBMS) measurements, and isotopically labelled compounds are used to determine the identity and rate of formation of pyrolysis products from HMX and RDX. It was found that both HMX and RDX decompose via two different reaction channels. One involves the transfer of an oxygen atom from the NO2 group to a carbon atom producing formaldehyde and N2O as the primary decomposition products along with HCN, H6C2N2O amides, and 1-nitroso 3,5,7-tinitro 1,3,5,7-tetraazacyclooctane in smaller quantities. For HMX this decomposition channel is autocatalytic and produces a nonvolatile residue below 260 C. The other decomposition channel involves the rupture of the N-N bond leaving hydroxy-s-triaxine as one of the primary decomposition products. In pure RDX the first decomposition products observed are associated with the N-N bond rupture channel. In RDX both reaction channels occur between 185 and 205 C, whereas in HMX the oxygen atom transfer and ring rupture decomposition channel starts at approximately 200 C and controls the decomposition through a temperature of at least 260 C. The experiments with deutrated HMX show evidence of the N-N bond rupture channel first starting at 292 C. No non-volatile residue is observed when the N-N bond rupture channel is present in either the HMX or RDX decomposition. Author

N88-25613# Colorado Univ., Boulder. Dept. of Mechanical Engineering.
STRUCTURE OF LAMINAR, PREMIXED FLAMES OF CH2O/NO2/O2 MIXTURES **c25**
M. C. Branch and M. Sadeqi *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 343-351 (For primary document see N88-25585 19-28)
(Grants AF-AFOSR-0006-84; NSF INT-86-04371)
Avail: NTIS HC A19/MF A01 CSCL 21B

Experimental measurements of species composition and temperature through the reaction zone of premixed, laminar, flat flames of CH2O/NO2/O2 mixtures are described. The flames with O2 as oxidizer have a blue luminous zone while the flames with NO2 as oxidizer have a yellow luminous zone. The flames with NO2 and O2 have two luminous zones one yellow and the other violet, separated by a distinct, dark nonluminous zone. Nitrogen dioxide is a poor oxidizer in comparison to O2 and, therefore, much of the NO2 remained untreated in the products. Very little NO reduction to N2 was observed and the flame temperatures were well below the adiabatic flame temperature. A reaction mechanism is discussed which accounts for the observations in the flame data. Author

N88-25614# IIT Research Inst., Chicago, Ill.
LASER-RDX AEROSOL PYROLYSIS WITH MATRIX ISOLATION OF UNSTABLE INTERMEDIATES **c25**
A. Snelson *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 353-358 (For primary document see N88-25585 19-28)
(Contract DAAG29-85-K-0143)
Avail: NTIS HC A19/MF A01 CSCL 21B

An experimental concept was investigated utilizing laser heating of aerosol particles to produce their rapid thermal decomposition under high vacuum conditions with subsequent matrix isolation of the primary reaction products for identification by IR spectroscopy. A suitable experimental system was assembled. An RDX aerosol (3 micron dia.) was subjected to heating with approximately 2 kW of CW CO2 laser irradiation. The decomposition product(s) were isolated in an argon matrix and subjected to IR analyses. Although the data were very limited, the IR spectrum of the RDX decomposition product(s) was not inconsistent with a primary decomposition mechanism in RDX that produced N-nitroformamine, H2C=N-NO2. An aerosol heating rate of equal to or approximately 2 million C/sec was estimated. Author

N88-25615# Sandia National Labs., Albuquerque, N. Mex. Combustion Research Facility.
THEORETICAL STUDIES OF THE CHEMICAL REACTIONS INVOLVED IN THE IGNITION OF NITRAMINES **c25**
Carl F. Melius *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 359-366 Sponsored in part by the Department of the Army, Washington, D.C. and DOE, Washington, D.C. (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 21B

The ignition of gaseous RDX was studied theoretically by solving the time-dependent nonlinear coupled differential equations for temperature and species mass fractions. Initial temperatures T sub 0 ranged from 500 to 1400 K and initial pressures varied from 1 to 100 atmospheres. The results indicate that the ignition process is complex, occurring in two stages. The first stage involves an ignition delay followed by a small temperature rise, resulting from the conversion of weakly-bound hydrogen (e.g., in CH2O and HONO) to H2O. The second stage involves a second delay time during which the NO2 is converted to NO. Ignition of the second involves a large temperature rise, resulting from the conversion of NO to N2. While the first ignition delay time decreases monotonically with T sub 0, the second ignition delay time decreases, then increases, and finally decreases with T sub 0. The temperature maximum resulting from the first stage ignition

first decreases with T sub 0 and then reverses and increases with increasing T sub 0. For higher T sub 0s, the initial decomposition processes leads to a drop in temperature before the first ignition stage occurs. The chemical reactions and reaction pathway occurring for each of the stages of ignition are discussed. Author

N88-25616# Naval Weapons Center, China Lake, Calif. Engineering Sciences Div.
TEMPERATURE AND SPECIES PROFILES IN PROPELLANT IGNITION AND COMBUSTION
Tim Parr and Donna Hanson-Parr *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 367-382 (For primary document see N88-25585 19-28)
(Contract N00014-87-BR-02402)
Avail: NTIS HC A19/MF A01 CSCL 19A

The chemistry and kinetics of the ignition and combustion of solid propellants were investigated. Experiments were performed using imaging Planar Laser Induced Fluorescence (PLIF) and this year, measurements were extended to obtain temperature profiles during CO2 laser ignition and steady state deflagration of HMX using selected rotational lines of the OH radical. All experiments were done at one atmosphere. The PLIF images of NO2 were refined, and imaging of NO using 2-photon PLIF was attempted. The PLIF images were also attempted for CH, NCO, and H2CO (formaldehyde). The NO2 and NO are initial products during laser ignition, beginning to form at minimum delay times and producing tall plumes until ignition occurs in the gas phase. The NO2 and NO PLIF signals are then confined to an expanding spherical shell plus a steady state solid core between the sample surface and the CN or NH flame sheet. The NO2 profile drops monotonically from the surface, implying that NO2 is being converted to NO through the dark zone. The NO2 and NO are early decomposition products which are consumed in a flame separated significantly from the surface. The CN and NH are produced in this flame as transient radicals. The OH rotational temperature profiles rise sharply at the CN/HN flame sheet and level off at about 2772 K beyond it. Little or no evidence for H2CO was seen. No signals were observed from either CH or NCO during combustion of HMX. Author

N88-25617# Morton Thiokol, Brigham City, Utah. Aerospace Group.
CHEMICAL KINETICS MODELING OF HMX COMBUSTION
R. L. Hatch *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 383-391 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 19A

A steady-state one-dimensional combustion model is used to treat the deflagration of HMX. The model employs a detailed set of elementary reactions to describe gas phase processes. Because the reaction rate data are taken from the chemical kinetics literature, there are no free parameters in the model. The effect on combustion of different mechanisms of decomposition are determined and some of the more important gas phase reactions are identified. Possible ways to modify key reactions to increase burn rate are suggested. In addition, a possible method to experimentally distinguish different decomposition mechanisms based on spectroscopic observations of the CN signature is described. Author

N88-25618# Morton Thiokol, Brigham City, Utah. Space Operations.
A MULTIPLE CHAMBER VOLUME-FILLING MODEL FOR PREDICTION OF TRANSIENT SOLID ROCKET MOTOR BALLISTIC PERFORMANCE **c20**
James Henderson *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 1 Oct. 1987 p 393-402 (For primary document see N88-25585 19-28)
Avail: NTIS HC A19/MF A01 CSCL 21H

A simple lumped parameter of multiple chamber volume-filling was developed for design and prediction of transient solid rocket motor ballistic performance. The conservation of mass and balance of energy principles are solved numerically for up to ten chambers connected in series. A one-dimensional finite difference formulation incorporating radiation and convection is solved for the in-depth temperature distribution of the solids which determined propellant ignition times. The gas mixture properties of a particular chamber are found by using the gas mixture properties from upstream and downstream chambers along with the gas properties of mass flow from the propellant surface. Charging conditions can be specified at the inlet of the first chamber and exit conditions specified at the outlet of the last chamber. This allows ballistic performance modeling with time dependent exit conditions and concatenation of systems of chambers. The capability of the program was demonstrated by modeling a subscale SRM test motor and a tactical dual pulse motor. The subscale SRM test motor simulates the full-scale SRM ignition transient. The test motor is nearly a closed volume. Comparison of theoretical results with experimental data detonates significant heat transfer due to a large, exposed insulation surface area. The dual pulse motor is designed with two chambers separated by a bulkhead which bursts at a specific pressure difference. This motor was modeled to show the independent ignition of the propellant in each chamber and the interaction of the chambers after bursting the bulkhead. Author

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.
For biological materials see *55 Space Biology*.

No abstracts in this category.

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N88-25619# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. JAPAN
4 May 1988 122 p Transl. into ENGLISH from various Japanese articles
(JPRS-JST-88-005) Avail: NTIS HC A06/MF A01

Translated articles from Japanese periodicals are presented. Subject headings are: Advanced materials; Aerospace, Civil aviation; Automotive industry; Computers; and Microelectronics. Some representative titles are: Research and Development Programs on Advanced Structural Ceramics in Korea; Ceramics Substrates for Semiconductor Applications; Basic Research in Supersonic Combustion; Aerodynamic Analysis of Natural Laminar Flow Airfoil; and Fractography of Heat Resistant Alloys. For individual titles, see N88-25620 through N88-25628.

N88-25620# Joint Publications Research Service, Arlington, Va.
RESEARCH AND DEVELOPMENT PROGRAMS ON ADVANCED STRUCTURAL CERAMICS IN KOREA **c27**
Byong Sik Jeon *In its* JPRS Report: Science and Technology. Japan 4 May 1988 p 1-15 Transl. into ENGLISH from Ceramics Japan (Tokyo, Japan), v. 22, Aug. 1987 p 643-650 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

The role of ceramics in the 21st century is briefly discussed, as are the research programs presently being pursued in Korea, its domestic market, and future prospects for research and development in the ceramics industry in Korea. Uses and fabrication techniques are also discussed. E.R.

N88-25621# Joint Publications Research Service, Arlington, Va.
CERAMIC SUBSTRATES FOR SEMICONDUCTOR APPLICATIONS REPORTED: AIN SUBSTRATES **c27**
Katsuaki Sugimoto *In its* JPRS Report: Science and Technology.

Japan 4 May 1988 p 16-31 Transl. into ENGLISH from Kino Zairyo (Tokyo, Japan), Sep. 1987 p 54-62 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

As progress continues in the field of semiconductor elements, the requirements to be met by substrates for semiconductors have been growing stricter. One of the upgraded requirements concerns thermal conductivity. Where the conventional alumina substrates cannot satisfactorily meet upgraded requirements, the needs for better substrate materials to be used instead of alumina have been rising. A general discussion is presented of the aluminum nitride substrates which have been put to practical use as substrates with high thermal conductivity. Author

N88-25622# Joint Publications Research Service, Arlington, Va.
AIN SUBSTRATE APPLICATIONS **c27**
Nobuo Iwase *In its* JPRS Report: Science and Technology. Japan 4 May 1988 p 32-44 Transl. into ENGLISH from Kino Zairyo (Tokyo, Japan), Oct. 1987 p 57-66 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

The types of presently available AIN substrates are outlined along with the precautions to be taken in using them. Also discussed in detail are the factors to be considered in planning the introduction of AIN substrates and the structures, properties and merits of AIN substrates including both those already in use and those still under research and development. Author

N88-25623# Joint Publications Research Service, Arlington, Va.
BASIC RESEARCH IN SUPERSONIC COMBUSTION **c25**
In its JPRS Report: Science and Technology. Japan 4 May 1988 p 48-51 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jan. 1988 p 2-4 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

An attempt is made to explain the mechanism by which supersonic combustion operates and to obtain the basic support data needed for designing stable, efficient combustion methods. This research begins by using laser Schlieren to make a two dimensional visualization of the flow when hot air simulating fuel is injected into the mainflow moving at M=2, and macroscopic observations are made by simultaneously measuring the static pressure distribution on the wall. Author

N88-25624# Joint Publications Research Service, Arlington, Va.
AERODYNAMIC ANALYSIS OF NATURAL LAMINAR FLOW AIRFOIL **c02**
N. Kawai and N. Hirose *In its* JPRS Report: Science and Technology. Japan 4 May 1988 p 51-54 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jan. 1988 p 5-6 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

Research into technology for laminar flow wings to greatly reduce aerodynamic frictional drag is being carried out as part of the research and development effort for innovative aviation technology to dramatically improve the performance of aircraft. Numerical analysis of natural laminar flow is discussed. Using methods of computational aerodynamics, the aerodynamic characteristics of natural laminar flow airfoils are analyzed. Specifically, using the beam warming method, a numerical analysis of the Navier-Stokes equation is performed by using a Baldwin-Lomax turbulence mode. The transition determination is modeled by empirical rules; that is, both the widely used Baldwin-Lomax determination and Michel's determination method are used and compared. Author

N88-25625# Joint Publications Research Service, Arlington, Va.
RESEARCH ON FRACTOGRAPHY OF HEAT-RESISTANT ALLOYS **c39**
H. Terada *In its* JPRS Report: Science and Technology. Japan 4 May 1988 p 54-55 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jan. 1988 p 6-8 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

With the progress made in fracture dynamics, the concept of admissible damage has become a part of designing aircraft fuselages and systems in order to achieve lighter weight while increasing aircraft safety. Since this concept allows a certain amount of crack defects, research is being carried out on fracture toughness along with experimental research concerning fatigue crack propagation behavior of materials for engine rotor disks under actual extreme conditions. The results are reported of fractography research by electronic microscope concerning fracture of samples gained through such testing. Study of fractures is also important as a way to determine their mechanism from the standpoint of preventing fracturing in structures. The materials used in the tests were titanium alloy for compressor disks and two types of nickel based alloys for high temperature turbine disks. Author

N88-25626# Joint Publications Research Service, Arlington, Va.
APPLICATION OF AI TO SPACE SYSTEMS **c63**
In its JPRS Report: Science and Technology. Japan 4 May 1988 p 55-58 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jan. 1988 p 8-10 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

The space station and other projects being developed through international cooperation with Japanese participation involve the construction of laboratories as a platform for various kinds of space experiments, such as experiments to create new materials using the space environment of weightlessness and vacuum, life science and observation experiments. The diverse, complex, and long term experiments done in space laboratory will be actually carried out by a small crew of passenger scientists. In carrying out space experiments it is necessary to make the crew's work in the space lab and the control and support from the ground more autonomous and intelligent, and to establish technology for running these experiments smoothly and efficiently. With this in mind, research has been conducted into space experiment support expert systems using artificial intelligence technology. Such systems can complement and take over part of the intellectual work of the crew. Author

N88-25627# Joint Publications Research Service, Arlington, Va.
VIBRATION TESTING OF ACT FUSELAGE **c05**
In its JPRS Report: Science and Technology. Japan 4 May 1988 p 58-59 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jan. 1988 p 10-11 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

The ACT fuselage model vibration testing was done in order to determine the vibration characteristics of the whole fuselage model before wind tunnel testing and then feed them back into the data analysis. A special frame for vibration testing was set up, and in order to obtain the vibration characteristics at any state during flight, sliding parts built into the model of the wind tunnel testing were used, only the front back and left right displacement of the model were constrained, and the center of gravity of the model was suspended with a spring coil in such a way as to not affect the vibration characteristics of the whole fuselage model. The vibration mode was determined using a small semiconductor gauge type accelerometer; 75 points on the entire fuselage were chosen as measurement points, and in taking measurements the positions of the detectors were moved about. The frequency response function was measured with a two channel Fast Fourier Transform analyzer, the modal analysis was done with a personal computer, and the modal parameters were determined, including the frequency, damping and vibration form. Author

N88-25628# Joint Publications Research Service, Arlington, Va.
NEW SUPER ALLOYS USED IN TURBOCHARGERS **c26**
Masashi Yoritaka, Yukio Yamamoto, Yasuaki Hasegawa, and Tomio Hokari *In its* JPRS Report: Science and Technology. Japan 4 May 1988 p 60-71 Transl. into ENGLISH from Jidosha Gijutsu

(Tokyo, Japan), Oct. 1987 p 1150-1155 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

The turbochargers now used by most automobile manufacturers have turbine blades of Inconel 713C. In recent years, however, exhaust gas temperatures have tended to increase because of the compatibility between high automobile output and low fuel consumption. At the same time, creep strength at high temperatures is a problem with turbine blades, which are subjected to great centrifugal forces as they turn at more than 100,000 rpm. The creep strength of Inconel 713C is not necessarily sufficient and this has been noted as an engineering bottleneck in the refinement of turbochargers. A new Ni base superalloy was used to replace the Inconel. Further, the heat resistance of turbine cases is also an important problem. Normally, high Si ductile cast iron or Ni resist ductile cast iron is used, but a Co based superalloy was used with drastically improved heat resistance. Author

N88-25629# Materials Research Labs., Melbourne (Australia).
BALLISTIC EVALUATION OF APPLIQUE ARMOURS: PRESENTATION AND INTERPRETATION OF BALLISTIC DATA
R. L. Woodward, B. J. Baxter, and R. G. ODonnell Feb. 1988 23 p
(MRL-TN-527; AR-005-204) Avail: NTIS HC A03/MF A01

Techniques of carrying out armor evaluations are reviewed. Attention is given to methods of comparison which use the residual penetration into a reference block, a method which is particularly useful with applique armors. It is shown how such data can be represented in terms of weight per unit area, and combined with velocity/range data to show the ranges at which armors are defeated as a function of weight. Author

N88-25630# National Aerospace Lab., Tokyo (Japan).
PROCEEDINGS OF THE 5TH NAL SYMPOSIUM ON AIRCRAFT COMPUTATIONAL AERODYNAMICS
Nov. 1987 259 p In ENGLISH and JAPANESE Symposium held in Tokyo, Japan, 25-26 Jun. 1987 Original contains color illustrations
(NAL-SP-8; ISSN-0452-2982) Avail: NTIS HC A12/MF A01

Topics addressed include: grid generation; computational fluid dynamics; numerical simulations; shuttle orbiter flow; finite element analysis of astrophysical jets; aerodynamic simulation; aircraft configurations; flow characteristics; hydrogen jets; cascade flow; and Navier-Stokes equations. For individual titles, see N88-25631 through N88-25667.

N88-25631# National Aerospace Lab., Tokyo (Japan).
ON THE NAL NUMERICAL SIMULATOR SYSTEM **c61**
Hajime Miyoshi and Masahiro Fukuda *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 1-11 In JAPANESE; ENGLISH summary Original contains color illustrations (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

The Numerical Simulator System installed at NAL Computational Sciences Division in February 1987 is working well for computational research activities. The background and the course of the system installation, the illustration of the system configuration and utilization, and the examples of advanced computational results are described. The factors affecting the progress of Research Computational Fluid Dynamics, primarily supercomputer hardware, are mentioned. Author

N88-25632*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL SIMULATIONS OF AERODYNAMIC CONTRIBUTION OF FLOWS ABOUT A SPACE-PLANE-TYPE CONFIGURATION **c02**
Kisa Matsushima, Susume Takanashi, Kozo Fujii (National Aerospace Lab., Tokyo, Japan), and Shigeru Obayashi *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 13-18 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

The slightly supersonic viscous flow about the space-plane under development at the National Aerospace Laboratory (NAL) in Japan was simulated numerically using the LU-ADI algorithm. The wind-tunnel testing for the same plane also was conducted with the computations in parallel. The main purpose of the simulation is to capture the phenomena which have a great deal of influence to the aerodynamic force and efficiency but is difficult to capture by experiments. It includes more accurate representation of vortical flows with high angles of attack of an aircraft. The space-plane shape geometry simulated is the simplified model of the real space-plane, which is a combination of a flat and slender body and a double-delta type wing. The comparison between experimental results and numerical ones will be done in the near future. It could be said that numerical results show the qualitatively reliable phenomena. Author

N88-25633# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATIONS OF FLOW AROUND SHUTTLE ORBITER **c02**
Satoru Ogawa, Tomiko Ishiguro, and Yoko Takakura (Fujitsu Ltd., Tokyo, Japan) *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 19-28 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

Numerical simulations of flow around the shuttle orbiter were performed by solving the 3-dimensional Euler equations. A numerical grid is generated for the whole configuration of the shuttle orbiter by using equations of mesh line orthogonality and cell volume which form a hyperbolic partial differential equation system. To increase the applicability of the hyperbolic grid generation scheme, the second metric tensor is used for the determination of cell volume, and the one-dimensional elastic model is used to relax the orthogonality condition of two coordinate lines. The transonic and supersonic flow around the shuttle orbiter are solved by using the Harten-Yee type TVD scheme. It is shown that the results of numerical flow simulation using the present method is reasonable. Author

N88-25634# National Aerospace Lab., Tokyo (Japan).
FINITE ELEMENT ANALYSIS OF INCOMPRESSIBLE VISCOUS FLOW AROUND MULTI-ELEMENT AEROFOILS **c34**
Masashi Shigemi *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 29-35 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

The Navier-Stokes equation was solved by the finite element method to simulate the laminar flow around airfoils. The concept of the penalty function method was introduced in the finite element method to simplify the implication of the incompressibility constraint. The streamline upwind/Petrov-Galerkin (SU/PG) method was also incorporated to avoid the numerical oscillation in the velocity field, which is known to appear when a simple finite element formulation is applied to flow problems in high Reynolds number region. Three examples were chosen to test the usability of the formulation developed. These are a flow around a symmetric airfoil with zero angle of attack, a flow around an airfoil which is known to show the laminar leading edge separation when the Reynolds number is fairly low, and a flow around an airfoil with flap. All flows obtained showed separation. The separated region of all examples experienced unsteady periodic shedding of vortices except the one on the symmetric airfoil with low Reynolds number, therefore the time marching follows of phenomena became necessary. The theta-method was used to integrate equations with respect to time, with theta between 0.5 and 0.55. The calculated result shows reasonably good agreement with the measured result which accompanies the laminar separation. Even if the airfoil is multi-elemented, there are no particular difficulties in application

of this formulation in comparison with the case when the airfoil is single-elemented. Author

N88-25635# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
NUMERICAL SIMULATIONS OF ASTROPHYSICAL JETS c34
Takuya Matsuda, Ryuji Ishii, Yoshikuni Umeda, Atsuhiko Yasuda, Keisuke Sawada, and Eiji Shima (Kawasaki Heavy Industries Ltd., Kagamihara, Japan) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 37-42 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

Propagation of astrophysical jets was investigated numerically by using the Osher method which has a second-order of accuracy in space and time. The characteristic structures of them, i.e., a beam, a lobe, a working surface, and a cocoon, were successfully simulated. It was found that those structures were very sensitive to the density ratio (gas density of the jet at the effective nozzle-exit divided by that of the ambient). In the present calculations, the ambient gas condition first introduced was applied on all the numerical boundaries. The numerical results have clearly shown that the ambient gas condition is better than the pressure condition adopted, for example, by Norman et. al. The ambient gas condition can be widely applied to other problems with numerical boundaries. Author

N88-25636# Nagoya Univ. (Japan).
NUMERICAL CALCULATION OF SUPERSONIC FLOW BY THE PNS EQUATIONS c02
Michiru Yasuhara and Yoshiaki Nakamura *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 43-48 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

The Parabolized Navier-Stokes (PNS) equations are examined. The Euler equation was previously solved by the finite volume method. The results showed good agreement with experimental results. Then, this was extended to include viscous effect by solving the Navier-Stokes equations, using the Beam-Warming scheme. These results also showed good agreement with the Euler code. Thermal effects on the Shuttle-like body could also be obtained. The PNS equations were employed in order to reduce CPU time. Actually the calculation time was reduced to some thousands as much as the thin layer Navier-Stokes equations. The two cases were calculated. One is a hemisphere cylinder, and the other is a hemisphere-elliptic cylinder at an attack angle. The first case was compared with the time-dependent thin-layer NS equations. The comparison between them was good. The second case showed the clear effect of the attack angle as the turn of the flow from the lower surface to the upper surface. Author

N88-25637# Fuji Heavy Industries Ltd., Utsunomiya (Japan).
NAVIER-STOKES ANALYSIS OF TRANSONIC TRANSPORT AIRCRAFT EMPENNAGE c02
Yasuhiro Koshioka, Keisuke Kamo, and Kanichi Amano (Japan Aircraft Development Corp., Tokyo.) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 49-54 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

Flow field simulations over transonic aircraft empennage were performed based on three-dimensional Navier-Stokes equations. The computations were done for the flow fields of various Mach numbers and angles of attack to investigate the variation of the life curve slope with the Mach number at low angle of attack, and the variation of the lift coefficient with the angle of attack at low Mach number. The value of the lift curve slope obtained by the computations show good agreement with those by experiments. While the difference between computations and experiments looks a little large about lift coefficient verses angle of attack. Author

N88-25638# Kyoto Univ. (Japan). Dept. of Engineering.
NUMERICAL SOLUTIONS OF THE EULER EQUATIONS FOR THE FLOW FIELD AROUND COUNTER-ROTATING PROPELLERS c02
Makoto Kobayakawa and Masahiro Nakao (Mitsubishi Heavy-Industries Ltd., Nagoya, Japan) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 55-63 In JAPANESE; ENGLISH summary Original language document was announced in IAA as A88-13544 (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

In order to investigate the flow field around the ATP through numerical methods for its optimal design, 3D-Euler equations are most prominent. The flow field around counterrotating propellers in advancing 0.8 Mach is obtained. Two spaces including front and rear blades are solved separately. The interaction between both blades are taken into the calculation by the connecting surfaces. The noniterative implicit ADI scheme is used in order to solve Euler equations. The periodic steady and averaged steady solutions are obtained. The latter is simplified by averaging the variables at the connecting surface. This shortens the calculation time to one-third compared with the periodic steady analysis which simulates the relative motion of the blades exactly. Numerical calculations are performed for two counter rotating ATP's with SR-1 and SR-3 blades. Both results show that they are similar to each other, and the propeller efficiencies increase compared with single rotating ATP with the same blades. Author

N88-25639# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
NUMERICAL SIMULATION OF SUPERSONIC FREE-JETS c02
Ryuji Ishii, Takuya Matsuda, Yoshikuni Umeda, Atsuhiko Yasuda, Keisuke Sawada, and Eiji Shima (Kawasaki Heavy Industries Ltd., Kagamihara, Japan) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 65-71 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

Axisymmetric underexpanded supersonic jets are investigated numerically. A time-dependent technique of solution is applied to solve the Euler equations for a compressible ideal gas. The characteristics of Mach disk obtained by the calculations are compared with the experiments and a good agreement is obtained. It is shown that the global jet structure with a nearly regular shock pattern which is stable and steady itself, is destabilized by the vortex rings (Kelvin-Helmholtz roll-up) on the jet boundary. These vortices produce shocks inside the jet, which are convected downstream with eddies. This strongly suggests that a time-independent or a time-converged solution cannot be expected without making a suitable time-averaging of the time-dependent solutions. Other important instabilities are also investigated. Author

N88-25640# Tokyo Univ. (Japan). Inst. of Computational Fluid Dynamics.
COMPUTATION OF FLOW AROUND NACA0012 AIRFOIL AT HIGH ANGLE OF ATTACK c02
Yoshifumi Shida and Kunio Kuwahara *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 73-79 In JAPANESE; ENGLISH summary Previously announced in IAA as A87-42448 (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

Transonic flow around a NACA0012 airfoil at high angle of attack is simulted by solving the two-dimensional Navier-Stokes equations. The block pentadiagonal matrix scheme is employed. Periodic phenomena of shock-wave vortex interaction are observed. For comparison, computation of subsonic flow was done. Small vortices are observed between the leading edge and the center of the chord. Author

N88-25641# National Aerospace Lab., Tokyo (Japan).
AERODYNAMIC SIMULATION FOR COMPLETE ASKA AIRCRAFT CONFIGURATION c02
Susumu Takanashi and Keisuke Sawada (Kawasaki Heavy Industries Ltd., Kagamihara, Japan) *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 81-84 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

A numerical simulation of transonic flows over complete ASKA aircraft configuration is performed. A computational grid system is constructed using the algebraic multi-block method. The Euler equations are numerically solved by the upwind finite volume scheme. Author

N88-25642*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL SIMULATION OF VISCOUS FLOWS OVER TRANSONIC AIRCRAFT CONFIGURATIONS c02
Susumu Takanashi, Masahiro Yoshida, Kozo Fujii, Kisa Matsushima (Fujitsu Ltd., Tokyo, Japan), and Shigeru Obayashi *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 65-89 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

Numerical simulation of compressible viscous flow fields is performed for a transonic transport configuration. A single structured grid system is constructed using analytical transformations such as conformal mapping, shearing/twisting/rotating/clustering/stretching transformations. The Reynolds-averaged, thin-layer Navier-Stokes equations are solved on a supercomputer, FACOM VP-400, using the LU-ADI factorization method. Author

N88-25643# National Aerospace Lab., Tokyo (Japan).
CALCULATIONS OF UNSTEADY AERODYNAMICS FOR A FULL AIRCRAFT CONFIGURATION USING BOUNDARY ELEMENT METHOD c02
Mitsunori Yanagizawa, Yoshiyuki Morita, and Shigefumi Tatsumi (Mitsubishi Heavy-Industries Ltd., Nagoya, Japan) *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 91-101 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

A boundary element method is presented for determining aerodynamic loadings on arbitrary configurations in oscillatory subsonic flow. Formulas (modified Morino's method) are given for the unsteady pressure distributions or unsteady force experienced in subsonic flow by the wing-store combination, oscillating in the torsional oscillations about a fixed axis parallel to the span and other oscillating modes (flapping, plunging). Interference effects from an underwing pylon store were analyzed. The method if finally verified through comparison with experiment for the model at angles of attack from -5 to +5 degrees, and reduced frequencies from 0.65 to 1.3 at low subsonic flow. Author

N88-25644# National Aerospace Lab., Tokyo (Japan).
RAREFIED GAS NUMERICAL WIND TUNNEL 3. UNIVERSAL CODE FOR THREE DIMENSIONAL BODIES c02
Katsuhisa Koura, Kinuyo Nakamura, Toshio Isobe, Kazuyo Suematsu, Masayuki Hatakeyama, and Toshiyuki Shimoji (Facom Hitac Co. Ltd., Japan) *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 103-107 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

The rarefied gas numerial wind tunnel is under construction using the null-collision direct-simulation Monte Carlo method. It is confirmed that the universal code (RGNWT) for three dimensional bodies is valid for general use. The vectorized code (RGNWTV) for the NAL NS system is successfully in progress. Author

N88-25645# Nissan Motor Co. Ltd., Tokyo (Japan).
A NUMERICAL ANALYSIS OF FLOW CHARACTERISTICS IN LASER PROPULSION SYSTEM c36
Toru Shimada and Takashi Abe (Tokyo Univ., Japan) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 109-114 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

For the purpose of the system design of the laser-thermal propulsion experiment chamber, a numerical simulation is conducted using a quasi-two dimensional axisymmetric mathematical model of Glumb and Krier. In order to simplify the local laser intensity calculation a computational grid of which one coordinate family is made rung along the laser beam was chosen. Calculations are carried out for various values of mass flow rate and laser incident power. Qualitative understanding is obtained in regard with the dependency of the laser beam absorption rate on these parameters. Author

N88-25646# National Aerospace Lab., Kakuda (Japan).
ANALYSIS OF FLOW THROUGH PUMP OF LARGE ROCKET ENGINE c20
Hitoshi Yamada and Yoshiaki Watanabe *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 115-119 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

A development of a large launch vehicle (H-II) started in 1985. The first stage of this launch vehicle uses a liquid oxygen (LOX)/hydrogen (LH2) engine (LE-7), which generates 1,180 KN in thrust. The National Aerospace Laboratory (NAL) takes charge of the LOX turbopump development till the prototype engine is completed. The LOX turbopump consists of a main pump, a preburner pump, and a single stage impulse turbine. The design rotational speed is 20,000 rpm, and the delivery pressure of the main pump is 20.3 MPa and the preburner pressure is 11.4 MPa, and the flow rate is 229.1 kg/s. The high rotational speed, large flow rate, and low suction pressure of the main pump require the combination of a cavitating inducer with three swept back helical blades and a main impeller. In order to design a high pressure and a high efficiency pump, it is necessary to analyze the pump blade passage flows in detail, using a three dimensional flow analysis method. The design method and the experiment, which was carried out using liquid nitrogen and liquid oxygen at the turbopump test facility of the NAL Kakuda Branch are described. The design method combines a streamline analysis and a blade to blade analysis. The predicted pump head coefficients are in reasonable agreement with the experimental results considering the pump efficiency. Because a large amount of data are usually necessary to calculate three dimensional flows, a method of calculating blade shapes correctly only by giving two blade angles at the impeller inlet and outlet is developed. Author

N88-25647# Iwaki Meisei Univ. (Japan).
NUMERICAL SIMULATION OF IGNITION OF HYDROGEN JET IN HOT AIR c25
Fumio Takayama, Shirou Taki, Toshitaka Fujiwara, Koichi Hayashi, and Akira Sakurai (Tokyo Denki Univ., Japan) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 121-127 In JAPANESE; ENGLISH summary Previously announced in IAA as A87-33954 (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

The purpose is to clarify the nonsteady aspects of mixing and ignition of hydrogen jets injected into air heated by rapid compression. A numerical model for hydrogen jets undergoing chemical reaction is developed on the basis of experimental findings. Basic equations of a chemically reactive, multicomponent, axisymmetric, viscous and heat conducting gas flow are discretized by the application of second-order explicit MacCormack method and the Flux-Corrected Transport smoothing technique. General

patterns of the computed density distribution of the jet in its early stages compare favorably with the corresponding experimental results deduced from Schlieren photographs. The ignition time measured by the amount of water production in the computation is generally consistent with that of hydrogen jet in the experiments. Author

N88-25648# Tohoku Univ., Sendai (Japan). Inst. of High Speed Mechanics.
NUMERICAL SIMULATION OF THE SHOCK TUBE FLOWS BY TVD SCHEME **c02**
Katsuhiro Itoh and Kazuyoshi Takayama *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 129-136 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

A computational and experimental investigation of unsteady transonic flow over an elliptical cylinder and an NACA0012 airfoil in a shock tube is presented. To simulate the unsteady transonic shock tube flow, a Total Variation Diminishing (TVD) finite difference scheme is applied to the Navier-Stokes equations. The complicated unsteady transonic flow accompanied by shock waves was successfully simulated with a high resolution. The computational isopycnics are consistent with those of the interferograms. Author

N88-25649# National Aerospace Lab., Tokyo (Japan).
NUMERICAL CALCULATION OF THREE DIMENSIONAL FLOW BY TVD SCHEME **c02**
Tomiko Ishiguro, Satoru Ogawa, and Yoko Takakura (Fujitsu Ltd., Tokyo, Japan) *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 137-146 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

Numerical simulations of flow around three dimensional complex configurations are performed by solving both the Euler and Navier-Stokes equations. Recent TVD schemes are used for two problems: subsonic/transonic/supersonic flow around a shuttle orbiter; and hypersonic inviscid/viscous flow in a scramjet inlet. It is shown that the results of numerical flow simulation using the present methods are reasonable. Author

N88-25650# National Aerospace Lab., Tokyo (Japan).
NUMERICAL ANALYSIS OF THREE DIMENSIONAL CASCADE FLOW BY SOLVING NAVIER-STOKES EQUATIONS **c34**
Osamu Nozaki, Kazuhiro Nakahashi, and Atsuhiro Tamura *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 147-156 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

Three-dimensional viscous flow fields in two different types of cascades, such as turbine nozzle and fan blade, were numerically simulated by solving the Navier-Stokes equations. For the turbine nozzle flows, computed flow patterns on a vane in stationary and rotating frames, and on a differently stacked vane were compared. In a fundamental case, the compared results showed good agreement with experimental data. Three dimensional flow separations as well as secondary flows caused by passage vortices could be predicted and effectively visualized using surface oil flow and streamline techniques, which were useful methods for three dimensional flow representation. Author

N88-25651# Tokyo Metropolitan Univ. (Japan). Coll. of Aeronautical Engineering.
SIMULATION OF AXISYMMETRIC FLOW WITH H2O2 REACTIONS **c34**
Shizui Watanabe *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 157-160 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

A simulation method of the conservation equations of fluid dynamics including transport properties and chemical kinetics is presented. It is constructed as follows: first, conservation equations (without species diffusion equations) are solved by a Newton-Raphson type iterative method; then velocities and mass fluxes are determined; second, species diffusion equations and enthalpy diffusion terms are evaluated explicitly; third, chemical kinetic equations are solved implicitly, then thermodynamic quantities and each molarity of chemical species are determined. For chemical kinetics, 9 chemical species and 22 elementary reactions are used. This simulation method is applied to analyze hydrogen jets into heated oxygen and argon mixtures. Author

N88-25652# National Aerospace Lab., Tokyo (Japan).
NUMERICAL ANALYSIS OF DUCT FLOW USING THREE-DIMENSIONAL PARABOLIZED NAVIER-STOKES EQUATION **c34**
Kazuo Kikuchi and Atsuhiro Tamura *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 161-168 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

The validity of a numerical solution procedure developed by Kikuchi and Tamura about three dimensional viscous compressible flow fields based on parabolized Navier-Stokes equations is examined by comparing the results of two experiments. The calculations for three dimensional flow fields in curved pipe and S-type duct with circular cross sections were performed. Qualitatively good numerical results were obtained. The discrepancies between the numerical and experimental results seem to be caused by inaccurate inlet conditions which were not explicitly designated in the experiments. Author

N88-25653# Kawasaki Heavy Industries Ltd., Kagamihara (Japan).
THE ROLE OF COMPUTATIONAL FLUID DYNAMICS IN AERONAUTICAL ENGINEERING (5). IMPROVEMENTS AND APPLICATIONS OF IMPLICIT TVD FINITE VOLUME CODE **c34**
Eiji Shima, Kenji Yoshida, and Kanichi Amano (Japan Aircraft Development Corp., Tokyo.) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 169-175 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

An automatic grid generator for multiple element airfoils was developed and the existing implicit Total Variation Diminishing (TVD) finite volume code was improved in both accuracy and efficiency, in order to make the Navier-Stokes solver a practical design tool for high lift devices. Utilizing these codes, Navier-Stokes analysis of the single slotted flap was carried out. The automatic grid generator utilizes the elliptic equation solver using the finite difference method combined with the panel method. The flow field is divided into subregions by the dividing stream lines which are calculated by the panel method and the computational grid in each subregion is generated by solving the elliptic equations (Thompson's method). Since the panel method can solve the potential flow around any number of arbitrary shaped bodies, this grid generator can generate a H-type computational grid around such bodies automatically. To obtain a high accuracy on a rapidly stretching grid, the flow solver uses the TVD formulation containing an explicit treatment of nonuniform grid spacing. Converging rate and numerical stability of the flow solver is augmented by the relaxation approach using Symmetric Point Gauss Seidel method in matrix inversion process which is necessary for an implicit scheme. Author

N88-25654# Mitsubishi Heavy-Industries Ltd., Nagasaki (Japan).
EXTENSIVE VERIFICATION OF BLADE-TO-BLADE FLOW CODE BASED ON DENTON SCHEME **c34**
Tomihiko Sato, Sunao Aoki, and Hedetaka Mori *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 177-181 In

JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

Recently, a computer-aided interactive design system was used for turbine design. The blade-to-blade flow program incorporated in the system is required to have short run times, robustness, and no limitations. The Denton time-marching code is as attractive as it is fast and can handle mixed subsonic-supersonic flows. The Denton scheme was published in 1982 and improvements were achieved in run times and entropy conservation. Firstly, code control variables are calibrated from the user's point of view. Factors affecting computing costs and accuracy are investigated, and the know-how necessary to operate the code efficiently is discussed. Secondarily, comparisons of calculated and experimental results are presented. Calculated surface Mach number distributions are compared with experimental data obtained from two-dimensional cascade tests for 23 cascades. For the nozzles, excellent agreement is obtained if the flows are fully subsonic, or transonic with weak shock-boundary layer interaction. For the blades, very good agreement is also obtained if the blades have moderate blade reaction and viscous effects are small. Satisfactory results are obtained for suction surface diffusion, even at off-design inlet conditions, if absolute values of incidence angle are less than 10 degrees. Author

N88-25655# Ishikawajima-Harima Heavy Industries Co. Ltd., Mizuho (Japan).
APPLICATION OF COMPUTATIONAL FLUID DYNAMICS TO DESIGN OF COMPRESSOR CASCADE **c34**
Teiichi Tamaki, Kaoru Chiba, Atsushi Shimizu, and Kenji Kobayashi *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 183-189 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

One of the most important problems for the gas turbine design engineers is to estimate the compressor and turbine cascade flow conditions. At the present time, an efficient cascade design tool will be obtained with the computational fluid dynamics. The results of numerical simulation were compared with some cascade experiments. A full potential analysis scheme with boundary layer correction was in good agreement with two-dimensional stational and rotational transonic cascade measurements. A controlled diffusion cascade designed with the new design procedure was tested and shown to have a good performance. Author

N88-25656# Kawasaki Heavy Industries Ltd., Kakamigahara (Japan).
ON THE ACCURACY OF UPWIND BIASED FINITE VOLUME METHOD **c34**
Keisuke Sawada and Susumu Takanashi *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 191-195 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

An improvement of the spatial accuracy of an upwind biased finite volume scheme adopting a pre-processing approach is investigated. In the pre-processing approach, the cell face values of the dependent variables are estimated with a higher order spatial accuracy at first, usually based on the Taylor expansion in the computational space, then numerical fluxes are determined by an appropriate method such as upwind scheme. A sufficient grid smoothness in the physical space is implicitly assumed when the Taylor expansion is applied to find the average slopes in the computational space. This can lead to a possible generation of numerical errors on the skewed grid system. In the present study, the distribution of conservative variables is fitted, rather in the physical space with the accuracy up to a third order, then the averaged slopes in each cell were found. Numerical experiments comparing various methods of finding the relevant averaged slopes including the present one are carried out. Author

N88-25657# National Aerospace Lab., Tokyo (Japan).
AN IMPLICIT, HIGH ORDER ACCURATE, UPWIND SCHEME FOR UNSTEADY EULER EQUATIONS **c34**
Kenichi Matsuno *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 197-200 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

An implicit finite-difference scheme for unsteady Euler equations is proposed. The quantities of the order of the square of the time-step are employed as unknowns of the scheme, which produces a delta-squared form of the algorithm. The present scheme has second-order time accuracy without iteration. The iteration process in the algorithm, which the scheme has as an option, improves the numerical accuracy and robustness. Numerical experiments show that the present scheme is very good not only for unsteady problems but also steady problems. Author

N88-25658# National Aerospace Lab., Tokyo (Japan). Computational Sciences Div.
ON THE PROPAGATING SPEED IN DIFFERENCE APPROXIMATIONS FOR CONSERVATION LAWS **c64**
Hideaki Aiso *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 201-207 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

There are various ways of analyzing or estimating finite difference approximations for differential equations. A way of analyzing finite difference approximations is proposed from the view point of propagation phenomena of conservation laws. Characteristics of conservation laws may be considered as routes on which small perturbations propagate. On the other hand difference equations approximating conservation laws have no concept of characteristics. But it is natural to think that propagation of a small perturbation in the difference approximation must have some ressemblance with that in the original conservation law. A condition for propagation phenomena of finite difference approximations to conservation law is proposed, and this condition imposes some compatibility with characteristics of the original conservation laws. The analysis based on this condition leads to the fact that, among explicit 3-point conservative difference approximations, only the upstream difference approximation (without any artificial viscosity) satisfies completely this condition. This fact may explain the importance of upstream finite difference approximations with a stronger theoretical foundation. Author

N88-25659# National Aerospace Lab., Tokyo (Japan).
ON SYMMETRIC TVD SCHEMES Abstract Only **c34**
Takayuki Aki *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 209 (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

An overview for a construction of a class of shock-capturing difference methods is presented. Scope of the overview extends over not only explicit but also implicit methods. Special emphasis will be on the concepts underlying the construction method rather than the techniques in practice, because practical schemes obtainable by applying the present method will be of wider variety than those obtained in the state-of-the-art developments. These possibilities also will be discussed when appropriate. Finally, some results of practical applications of the present method will be reviewed. Author

N88-25660# Fujitsu Ltd., Tokyo (Japan).
ON THE STATIONARY SOLUTIONS OF THREE-DIMENSIONAL EULER EQUATIONS BY THE TVD DIFFERENCE SCHEMES **c34**
Yoko Takakura, Tomiko Ishiguro, and Satoru Ogawa (National Aerospace Lab., Tokyo, Japan) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 211-216 In JAPANESE; ENGLISH

summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

Numerical estimations are performed for the improved TVD schemes (Harten-Yee and Chakravarthy-Osher numerical fluxes) and also for the classical schemes with artificial dissipation models (Beam-Warming and Obayashi numerical fluxes) through a series of numerical experiments for three-dimensional inviscid flows around the ONERA M6 wing. Numerical experiments indicate that the two TVD numerical fluxes are excellent in the points that they capture shock waves without numerical oscillations and rapid expansions sharply and that they have the robustness and the self-adjusting mechanisms regarding the numerical viscosity. On the other hand the Obayashi numerical flux is not capable of capturing the rapid expansions sharply like the Beam-Warming numerical index, although the former captures the shock waves without numerical oscillations. Author

N88-25661# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF TRANSITION TO TURBULENCE IN PLANE POISEUILLE FLOW BY A SPECTRAL METHOD **c34**
Kiyoshi Yamamoto and Iwao Hosokawa (Iwate Univ., Morioka, Japan) *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 217-232 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

Direct numerical simulation of the transition process from laminar to turbulent plane Poiseuille flow is carried out using a computing method derived from the Fourier spectral method. The subcritical nonlinear instability for a three-dimensional small disturbance, which is induced by the basic flow plus the two-dimensional finite amplitude T-S wave, is investigated at a Reynolds number, 5000. The two distinct secondary instability mechanisms, the peak-valley splitting and the resonance interaction between the T-S wave and a pair of subharmonic oblique waves, are obtained depending on a slight difference being in the initially given three-dimensional small disturbances. The mechanisms correspond to the experimental observation in the boundary layer on a flat plate. The transition is accelerated by the growing three-dimensional disturbances and the turbulent flow obtained agrees well with the experimental observation. Author

N88-25662# Ministry of Transportation, Tokyo (Japan). Ship Research Inst.
NUMERICAL SIMULATION OF TURBULENT FLOW USING THE EXPONENTIAL EXPRESSION OF k-EPSILON EQUATION **c34**
Munehiko Hinatsu and Yoshiaki Kodama *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 225-232 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

A numerical simulation of a turbulent flow around a wing section by use of the kappa-epsilon turbulence model is presented. In order to assure the positiveness of kappa and epsilon, the exponential expression of kappa-epsilon is used. The IAF method is adopted as a computational scheme. A treatment for the boundary condition on the wing surface is devised. A turbulent flow around NACA0012 wing section with 5 deg angle of attack at Re = 1 million is simulated. Author

N88-25663# Chiba Univ. (Japan). Faculty of Engineering.
RELAXATION SCHEME FOR COMPRESSIBLE FLOWS **c34**
Nobuhide Nishikawa and Akira Suzuki *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 233-239 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

The flow structure of compressible flows over a circular lump or spherical blunt body are numerically analyzed by Line Gauss Seidel relaxation algorithm including verification of the available studies. For compressible flow the Euler equation on tranformed coordinate is expressed as a delta form and time linearization to the system of conservation reduced to the unfactored expression together with flux splitting. The lines for which the Gauss Seidel system are applied are chosen parallel to oncoming flow direction. The CFL number can be chosen dramatically large and the number of iterations until convergence in the time marching problem is about 10, especially for supersonic flows. Author

N88-25664# Keio Univ., Yokahama (Japan). Faculty of Science and Technology.
THE MODIFIED-FLUID-IN-CELL METHOD TO WHICH ADAPTIVE MESH AND MULTIGRID WERE APPLIED **c34**
Ikuo Ono, Kentaro Motoda, Eriya Kanai, and Tsuneyo Ando *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynammics Nov. 1987 p 241-246 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

The compressible flow fields are analyzed, including shock wave numerically, the solution diverges because of the discontinuity of shock. If modified Fluid-in-Cell-Method is used, the discontinuity is artificially smoothed and the flow field is analyzed. Stability and accuracy of the solution depend on a mesh system in the analysis by the modified Fluid-in-Cell-Method. The algorithm is proposed in order to decrease the influence of a mesh system and the calculation time. It includes Adaptive Mesh Method and Multigrid Method. Using the Adaptive Mesh Method makes it possible to calculate the flow field without the influence of a mesh system. When a fine mesh is used to get a high accurate solution, many more steps and computational time are necessery. So the Multigrid Method is used in the present algorithm. Calculation of a supersonic flow field around a blunt nosed body is carried out. In comparison with previous methods, it takes less calculation time and good calculation results are obtained with respect to the shock wave and pressure contours. Author

N88-25665# Tsukuba Univ. (Japan). Inst. of Engineering Mechanics.
GRID GENERATION OF A HELICOPTER ROTARY-WING **c02**
Alain Carcasses and Y. Yoshizawa *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 247-253 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

A method of an elliptic grid generation for a helicopter rotary-wing is proposed. The main purpose of this work is flexibility for expected several flight conditions of helicopters. The elliptic grid generation is reduced to the method of solution of a large scale simultaneous equations. Three-dimensional grid points are rearranged into one-dimensional vectors, of which components are all the grid points in a surface of generated curvilinear coordinates. The SOR method is applied to the one-dimensional vectors in a checker board manner, and the conjugate gradient method is used to solve each equation. In the range of test calculation the proposed method is satisfactory from the viewpoints of numerical calculations. More efficiency, however, would be required for the grid generation in a larger scale of calculation. Author

N88-25666# Tokyo Metropolitan Univ. (Japan). Coll. of Aeronautical Engineering.
THEORY OF NUMERICAL INFORMATION ENVIRONMENT AND ITS APPLICATIONS **c61**
Masayuki Hatakeyama *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 255-259 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

A concept of Numerical Information Environment (NIE) and its actual method of system constitution was proposed. The NIE was studied and developed to store, analyze, and simulate a large scaled numerical data and information of a target (natural

phenomena or an artificial structure) interactively and iteratively. First, a global concept of numerical information and numerical information world are defined. To establish and operate the NIE, a concept of software bus (1,2,3) and its actual programming method were developed on the basis of the world. The software bus system always plays the role of a distributing center of all the numerical data and information, and is also a general method to transmit them among the modules in the NIE and between the processes in the UNIX. By using the software bus system, any kinds of direct numerical simulation or analyses programs can be mounted on the software bus system. One more feature is that any modules in the NIE can directly be used in the user's program system without any modification of the source program. Therefore, the system make-up is rapidly performed and operation of the NIE is flexible. To get a view of this database oriented system, a bus view system was developed with the aid of a graphic system. An application system named Dynamic DB System is described. It is concluded that the NIE is suitable for drawing various interesting and valuable knowledge or view of the user's target. Author

N88-25667# Fujitsu Ltd., Kawasaki (Japan).
CELLULAR ARRAY PROCESSOR (CAP) AND ITS APPLICATION TO COMPUTER GRAPHICS **c62**
Hiroyuki Sato, Kouichi Murakami, Morio Ikesaka, Hiroaki Ishihata, and Mitsuo Ishii *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 261-269 In JAPANESE; ENGLISH summary Original contains color illustrations (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

A general purpose highly parallel computer Cellular Array Processor (CAP) was developed. The CAP consists of 64 processors configured in a two-dimensional array. Communication between cells is done in two ways: Global communication using a common bus and local communication using inter-cell communication lines. Each cell has video memory for subimage storage. A frame of image data distributed to many cells is displayed directly on a monitor through the video bus. A multi-task real-time operating system called Cell Monitor was developed for efficient parallel processing. The CAP was applied to computer graphics. High quality image generation using ray tracing is efficiently performed on the CAP. Performance in ray tracing with 64 cells reaches 80 percent of Fujitsu's M-380 main frame computer. Author

N88-25668*# National Aeronautics and Space Administration, Washington, D.C.
STUDY OF A MAGNETIC REFRIGERATOR FOR SPACE APPLICATIONS FOR TEMPERATURES UNDER 20 K
P. Seyfert Jun. 1988 35 p Transl. into ENGLISH of Etude d'un Refrigerateur Magnetique a Vocation Spatiale pour des Temperatures Inferieures a 20 Kelvins, Commissariat a l'Energie Atomique Grenoble (France), 26 May 1986 p 1-48 Original language document was announced as N87-26240 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4703)
(NASA-TT-20283; NAS 1.77:20283; CENG-Note-SBT/CT/86-18; ESA-CR(P)-2311; ETN-87-99866) Avail: NTIS HC A03/MF A01 CSCL 11G

A thermodynamical analysis of the integration of a magnetic cycle in a refrigeration cycle; the process configuration choices; and the implementation of the first design of a last stage refrigeration step within a minimal overall weight design concept are summarized. The feasibility of magnetic cooling to 4 K design temperature is demonstrated. Compared to Joule-Thompson systems, the overall weight is of the same order. Author

N88-25669# Georgia Inst. of Tech., Atlanta. Research Inst.
SUBMUNITIONS SIMULATIONS, VOLUME 2 Final Report, 4 Jan. - Sep. 1985
J. L. Sims and R. W. Kearney Nov. 1987 119 p
(Contract DAAH01-84-D-A029)
(TR-CR-RD-SS-87-7-Vol-2) Avail: NTIS HC A06/MF A01 CSCL 19A

Several improvements were made to a computer program to enable the program to handle more types of geometric shapes and to allow the use of more source/sinks and body segments which are required for bodies with multiple cavities. Extensive calculations were made for a covered dispenser missile and were compared to experimental data in the MICOM data base. These calculations cover the entire range of parametric variables available in the data base. In general, the agreement between the data and analysis is very good. However, the comparisons did reveal two areas where the analytical results consistently failed to agree with the data. First, the linear theory does not calculate the shock shape which results in poor submissile forces and moments when the submissile in the vacinity of the shock. Second, when the submissile is at large angles of attack either the normal force or pitching moment coefficients are poorly matched, depending upon whether or not nonlinear cross flow forces are included. Neither option results in good predictions for both coefficients. When the submissile angle of attack is five degrees, or less, both coefficients are very well predicted. Author

N88-25670# Allied-Signal Corp., Kansas City, Mo.
TECHNICAL FEASIBILITY STUDY OF APPLYING AUTO-CONTROL METHODS TO PLATING PROCESS SOLUTIONS
C. L. Barben Mar. 1988 71 p
(Contract DE-AC04-76DP-00613)
(DE88-008014; BDX-613-3909) Avail: NTIS HC A04/MF A01

This study was undertaken to quantify the feasibility of applying auto-controllers to metal finishing tanks in one Allied-Signal Inc., Kansas City Division plating department. Traditionally, analysis and correction have been performed manually; however, because of higher material and operating costs and the increased number of processing tanks, an automated approach is now sought to reduce cost and labor burdens. Literature and market searches were performed to discover the latest concepts, activities, and available equipment in the field of chemical auto-controllers. A ranking methodology was developed and the processing solutions were ranked for auto-control feasibility. DOE

N88-25671# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
LA RECHERCHE AEROSPATIALE, BIMONTHLY BULLETIN, NO. 1986-5, 234/SEPTEMBER-OCTOBER
Claude Sevestre, ed. Mar. 1987 75 p Transl. into ENGLISH of La Recherche Aerospatiale, Bulletin Bimestriel (Paris, France), no. 1986-5, 234/September-October
(ESA-TT-1032) Avail: NTIS HC A04/MF A01

A shock-fitting technique is proposed for solving hyperbolic problems with spectral methods. In the case of an existing shock, the domain of computation is divided following the shock line. In each of the two resulting subdomains the solution is very regular and approximated with spectral accuracy. When a new discontinuity appears during the computation, this appearance has to be defined with a spectral accuracy in order to subdivide the computation domain and adjust the subdomains. In both cases the numerical results are obtained for the Burgers' equation and the one-dimensional isentropic Euler equations. Author

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N88-25672# Gosudarstvennyj Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.
COLOR CHARGE MOTION IN NON-ABELIAN FIELDS
A. I. Alekseev 1987 17 p In RUSSIAN; ENGLISH summary
(TI88-701306; IFVE-OTF-87-46) Avail: NTIS (US Sales Only)
HC A03/MF A01

The problem of the motion of a probe color charge in a static non-Abelian spherically symmetric field configuration (Wu-Yang anzatz for vector-potential) has been reduced to the problem of an electrically charged particle motion in effective electromagnetic field with an additional interaction of a definite form. The motion of the color particle is investigated for a pure monopole chromomagnetic field with unfixed chromoelectric field, for the case of zero total angular momentum for dyon point-like field configurations, for the constant color vector, for chromoelectric field configurations. DOE

N88-25673# Naval Ocean Systems Center, San Diego, Calif.
NARRATIVE COMPRESSION CODING FOR A CHANNEL WITH ERRORS Professional Paper, period ending Jun. 1987
James W. Bond Jan. 1988 17 p
(AD-A191577) Avail: NTIS HC A03/MF A01 CSCL 25E

Data compression codes offer the possibility of improving the thruput of existing communication systems in the near term. This study was undertaken to determine if data compression codes could be utilized to provide message compression in a channel with up to a 0.10 bit error rate. The data compression capabilities of codes were investigated by estimating the average number of bits-per-character required to transmit narrative files. The performance of the codes in a channel with errors (a noisy channel) was investigated in terms of the average numbers of characters-decoded-in-error and of characters-printed-in-error-per-bit-error. Results were obtained by encoding four narrative files, which were resident on an IBM-PC and use a 58 character set. The study focused on Huffman codes and suffix/prefix comma-free codes. Other data compression codes, in particular, block codes and some simple variants of block codes, are briefly discussed to place the study results in context. Comma-free codes were found to have the most promising data compression because error propagation due to bit errors are limited to a few characters for these codes. A technique was found to identify a suffix/prefix comma-free code giving nearly the same data compressions as a Huffman code with much less error propagation than the Huffman codes. Greater data compression can be achieved through the use of this comma-free code word assignments based on conditioned probabilities of character occurrence. GRA

N88-25674# Naval Ocean Systems Center, San Diego, Calif.
SIGNAL PROCESSING COMPUTATIONAL NEEDS Professional Paper, period ending Aug. 1986
Jeffrey M. Speiser Nov. 1987 6 p
(AD-A191756) Avail: NTIS HC A02/MF A01 CSCL 12E

Previous reviews of signal processing computational needs and their systolic implementation have emphasized the need for a small set of matrix operations, primarily matrix multiplication, orthogonal triangularization, triangular backsolve, singular value decomposition, and the generalized singular value decomposition. Algorithms and architectures for these tasks are sufficiently well understood to begin transitioning from search to exploratory development. Substantial progress has also been reported on parallel algorithms for updating symmetric eigensystems and the singular value decomposition. Another problem which has proved to be easier than expected is inner product computation for high-speed high resolution predictive analog-to-digital conversion. Although inner product computation in a general setting will require O(log n) time via a tree, the special structure of the prediction permits the use of a systolic transversal filter, producing a new predicted value in time O(1). Problem areas which are still in an early stage of study include parallel algorithms for the Wigner-Ville Distribution function, L1 norm approximation, inequality constrained least squares, and the total least squares problem. GRA

N88-25675# Naval Ocean Systems Center, San Diego, Calif.
THE NEW MININEC (VERSION 3): A MINI-NUMERICAL ELECTROMAGNETIC CODE Report, period ending Mar. 1987
J. C. Logan and J. W. Rockway Oct. 1987 6 p
(AD-A191778) Avail: NTIS HC A02/MF A01 CSCL 12E

The Mini ELECTROMAGNETICS Code, or MININEC, is a method of Moments computer programs for analysis of thin wire antennas. A Galerkin procedure is applied to an electric field integral equation to solve for the wire currents. This formulation results in an unusually short computer program suitable for implementation on a microcomputer. Hence, MININEC is written in a BASIC language compatible with many popular microcomputers. GRA

N88-25676# IIT Research Inst., Chicago, Ill.
EXTREMELY LOW FREQUENCY (ELF) COMMUNICATIONS SYSTEM ECOLOGICAL MONITORING PROGRAM: SUMMARY OF 1986 PROGRESS Technical Report, 1 Jan. - 31 Dec. 1986
John E. Zapotosky Dec. 1987 93 p
(Contract N00039-84-C-0070)
(AD-A192014; IITRI-E06549-39) Avail: NTIS HC A05/MF A01 CSCL 12A

A long-term Ecological Monitoring Program is being conducted to monitor for possible effects from the operation of the U.S. Navy's ELF Communications System to resident biota and their ecological relationships. Monitoring studies were selected through a peer reviewed, competitive bidding process in mid-1982 and work on most studies began in late summer of that year. Preliminary activities of the Program consisted of site selection, characterization of critical study aspects, and validation of assumptions made in original proposals. Subsequently, increasing emphasis has been placed on the collection of preoperational and operational data bases at the Michigan and Wisconsin Transmitting Facilities. The data bases are being used to make proposed spatial and/or temporal comparisons of biological and ecological variables. This report summarizes the progress of the Ecological Monitoring Program during 1986. GRA

N88-25677# Research and Development Labs., Culver City, Calif.
EXTREMELY LOW FREQUENCY (ELF) COMMUNICATIONS PROGRAM: NON-IONIZING ELECTROMAGNETIC RADIATION LITERATURE EVALUATION AND ASSESSMENT, 1986-1987 LITERATURE REVIEW Final Report No. 2
Nov. 1987 128 p
(Contract N00039-86-C-0136)
(AD-A192024; RDL-27) Avail: NTIS HC A07/MF A01 CSCL 25B

This report deals with the evaluation and assessment of literature concerned with the bioeffects of Extremely Low Frequency Electromagnetic Radiation. The report covers the period from November 1986 to October 1987. The objective of this program is to conduct a thorough and comprehensive review and evaluation, of the published professional literature containing scientific information pertaining to biological effects, including but not limited to human health effects of nonionizing electromagnetic radiation, germane to the Extremely Low Frequency (ELF) Communication Program of the United States Navy. The published professional literature reviewed, evaluated and assessed includes books, research reports, and articles and papers in peer-reviewed journals that discuss and/or describe biological and health effects of nonionizing electromagnetic radiation in the frequency range of 1-300 Hz. In some instances documents discussing effects of frequencies above 300 Hz were also reviewed. The review and

evaluation included both domestic and international literature published in English or other foreign languages. GRA

N88-25678# Naval Environmental Prediction Research Facility, Monterey, Calif.
THE EFFECTS OF BETTER ENVIRONMENTAL INPUTS IN ESTIMATING SEA CLUTTER Final Technical Report, Feb. - Oct. 1987
Tak K. Cheung Jan. 1988 29 p
(AD-A192058; NEPRF-TR-88-01) Avail: NTIS HC A03/MF A01 CSCL 20N

Microwave radars deployed near the marine environment, e.g., shipboard and airborne radars, are subjected to sea return or sea clutter. In many instances, sea return for radars at large angles of incidence or small grazing angles (less than 15 deg) is of special importance. This study examines the effects of better environmental inputs to an existing sea clutter model that has proven to be adequate for small grazing angles. Limitations in the existing model are described, improvements are suggested, and plans for improving the model are outlined and discussed. GRA

N88-25679# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.
ANALYSIS OF ANNULAR MICROSTRIP ANTENNAS FOR HYPERTHERMIC APPLICATORS
E. Alanen Jan. 1988 14 p
(PB88-181508; ISBN-951-754-381-6; Rept-21) Avail: NTIS HC A03/MF A01 CSCL 20N

An annular microstrip antenna in contact with the skin is analyzed by using the exact image principle. The antenna is designed primarily for measurements of temperature profiles in the breast and hence to detect cancer. The current distribution on the strip is solved from the electric field integral equation. The Galerkin's method is applied with continuous trigonometrical basis functions and the consequent nearfield distributions for different antennas are plotted. The dependence of the focus size on the radius of the antenna is calculated. Also, it is shown that the focus can be reduced by using two annular rings together. GRA

N88-25680*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROCEEDINGS OF THE MOBILE SATELLITE CONFERENCE
William Rafferty May 1988 536 p Conference held in Pasadena, Calif., 3-5 May 1988 Sponsored by NASA, Washington
(Contract NAS7-918)
(NASA-CR-182964; NAS 1.26:182964; JPL-Publ-88-9) Avail: NTIS HC A23/MF A01 CSCL 17B

A satellite-based mobile communications system provides voice and data communications to mobile users over a vast geographic area. The technical and service characteristics of mobile satellite systems (MSSs) are presented and form an in-depth view of the current MSS status at the system and subsystem levels. Major emphasis is placed on developments, current and future, in the following critical MSS technology areas: vehicle antennas, networking, modulation and coding, speech compression, channel characterization, space segment technology and MSS experiments. Also, the mobile satellite communications needs of government agencies are addressed, as is the MSS potential to fulfill them. For individual titles, see N88-25681 through N88-25758.

N88-25681*# Transit Communications, Inc., Pasadena, Calif.
THE AMSC MOBILE SATELLITE SYSTEM
Carson E. Agnew, Jai Bhagat, Edwin A. Hopper, John D. Kiesling, Michael L. Exner, Lawrence Melillo, Gary K. Noreen, and Billy J. Parrott (Satellite Mobile Telephone Co.) *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 3-9 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The American Mobile Satellite Consortium (AMSC) Mobile Satellite Service (MSS) system is described. AMSC will use three multi-beam satellites to provide L-band MSS coverage to the United States, Canada and Mexico. The AMSC MSS system will have several noteworthy features, including a priority assignment processor that will ensure preemptive access to emergency services, a flexible SCPC channel scheme that will support a wide diversity of services, enlarged system capacity through frequency and orbit reuse, and high effective satellite transmitted power. Each AMSC satellite will make use of 14 MHz (bi-directional) of L-band spectrum. The Ku-band will be used for feeder links. Author

N88-25682*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
NASA'S MOBILE SATELLITE DEVELOPMENT PROGRAM
William Rafferty, Khaled Dessouky (Telos Aerospace Systems, Calif.), and Miles Sue *In its* Proceedings of the Mobile Satellite Conference May 1988 p 11-22 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

A Mobile Satellite System (MSS) will provide data and voice communications over a vast geographical area to a large population of mobile users. A technical overview is given of the extensive research and development studies and development performed under NASA's mobile satellite program (MSAT-X) in support of the introduction of a U.S. MSS. The critical technologies necessary to enable such a system are emphasized: vehicle antennas, modulation and coding, speech coders, networking and propagation characterization. Also proposed is a first, and future generation MSS architecture based upon realized ground segment equipment and advanced space segment studies. Author

N88-25683*# Telesat Canada, Ottawa (Ontario). Satellite Service Planning and Development.
MOBILE SATELLITE SERVICE FOR CANADA
David Sward *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 23-29 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The Mobile Satellite (MSAT) system and a special program designed to provide interim mobile satellite services (IMSS) during the construction phase of MSAT are described. A mobile satellite system is a key element in extending voice and and data telecommunications to all Canadians. Author

N88-25684*# Aussat Proprietary Ltd., Sydney (Australia). Space Div.
AUSSAT MOBILE SATELLITE SERVICES
Wayne L. Nowland, Michael Wagg, and Daniel Simpson *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 31-36 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

An overview of AUSSAT's planned mobile satellite system is given. The development program which is being undertaken to achieve the 1992 service date is described. Both business and technical aspects of the development program are addressed. Author

N88-25685*# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Communications Satellite Dept.
A SATELLITE SYSTEM FOR LAND-MOBILE COMMUNICATIONS IN EUROPE
P. Bartholome and R. Rogard *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 37-42 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

There exists a great unsatisified demand for land mobile communications in Europe, particularly in sectors of business activity such as the road transport industry. This demand could best be satisfied by means of satellite-based private networks providing voice and data communications in a hub configuration. The potential market is estimated to encompass several hundred thousand road vehicles and the transmission capacity required would be several thousand channels. ESA is currently demonstrating the potential of satellite communications for this

type of application, using a system called PRODAT. System studies are being performed with the aim of defining the architecture of a regional satellite system for Europe. Author

N88-25686*# Ford Aerospace and Communications Corp., Palo Alto, Calif. Space Systems Div.
SYSTEM CAPACITY AND ECONOMIC MODELING COMPUTER TOOL FOR SATELLITE MOBILE COMMUNICATIONS SYSTEMS
Robert A. Wiedeman, Doong Wen, and Albert G. McCracken *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 43-49 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

A unique computer modeling tool that combines an engineering tool with a financial analysis program is described. The resulting combination yields a flexible economic model that can predict the cost effectiveness of various mobile systems. Cost modeling is necessary in order to ascertain if a given system with a finite satellite resource is capable of supporting itself financially and to determine what services can be supported. Personal computer techniques using Lotus 123 are used for the model in order to provide as universal an application as possible such that the model can be used and modified to fit many situations and conditions. The output of the engineering portion of the model consists of a channel capacity analysis and link calculations for several qualities of service using up to 16 types of earth terminal configurations. The outputs of the financial model are a revenue analysis, an income statement, and a cost model validation section. Author

N88-25687*# Aeronautical Radio, Inc., Annapolis, Md. AvSat Program.
DEVELOPING A GLOBAL AERONAUTICAL SATELLITE SYSTEM
Donald K. Dement *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 51-56 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Arinc, an airline industry-owned and operated company in the United States, has taken steps toward establishing a global aeronautical satellite communications system. Plans call for initiation of a thin-route data operation in 1989, upgrading to establish voice communications via shared spot-beam transponders carried on other satellites, and deploying a worldwide network using dedicated satellites by 1994. Author

N88-25688*# International Maritime Satellite Organization, London (England). Aeronautical Dept.
WORLD-WIDE AERONAUTICAL SATELLITE COMMUNICATIONS
Peter Wood and Keith Smith *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 57-62 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

INMARSAT decided to expand the spectrum covered by its new generation of satellites, INMARSAT-2, to include 1 MHz (subsequently increased to 3 MHz) of the spectrum designed for aeronautical use. It began a design study that led to the specifications for the system that is now being implemented. Subsequently, INMARSAT awarded contracts for the design of avionics and high gain antennas to a number of manufactures, while several of the signatories that provide ground equipment for communicating with the INMARSAT satellites are modifying their earth stations to work with the avionic equipment. As a result of these activities, a world-wide aeronautical satellite system supporting both voice and data will become operational in 1989. Author

N88-25689*# Omninet Communications Services, Los Angeles, Calif.
AN OVERVIEW OF THE OMNITRACS: THE FIRST OPERATIONAL MOBILE KU-BAND SATELLITE COMMUNICATIONS
Allen Salmasi *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 63-68 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The service features of the OmniTRACS system developed by Omninet Communications Services of Los Angeles, California are described. This system is the first operational mobile Ku-band satellite communications system that provides two-way messaging and position determination and reporting services to mobile users on a nationwide basis. The system uses existing Ku-band satellites under a secondary international allocation for mobile satellite services. Author

N88-25690*# Freibaum (Jerry), Bethesda, Md.
INTERNATIONAL AND DOMESTIC MOBILE SATELLITE REGULATORY PROCEEDINGS: A COMPARISON OF OUTCOMES AND DISCUSSION OF IMPLICATIONS
Jerry Freibaum *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 71(a)-71(f) (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

It is argued that we are on the threshold of a new multibillion dollar industry that can enhance economic development, dramatically improve disaster assessment and relief operations, improve rural health care and solve many safety and security concerns of the transportation industry. Further delays in resolving conflicts between vested interests will be extremely costly to users, providers and equipment manufacturers. Conference participants are urged to move quickly and decisively towards solving outstanding problems. Author

N88-25691*# International Maritime Satellite Organization, London (England).
MOBILE SATELLITE SERVICES: INTERNATIONAL CO-ORDINATION, CO-OPERATION AND COMPETITION
Olof Lundberg *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 71-78 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

In the context of a discussion of international cooperation, coordination and competition regarding mobile satellite services, it is asserted that: there will be more than one civil mobile satellite service in the 1990's; competition between these separate mobile satellite systems is inevitable; no system should enjoy monopoly protection or subsidies; and coordination and cooperation are desirable and necessary, since the available L-band spectrum is in short supply. Author

N88-25692*# Telesat Canada, Ottawa (Ontario). Communications Systems Engineering.
INTERNATIONAL AND DOMESTIC REGULATOR ISSUES FACING THE CANADIAN MSAT SYSTEM
Azarbar Bahman, Jacques R. Langlois, and Christopher J. Frank *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 79-84 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

International and domestic regulatory issues which affect the implementation of a mobile satellite system (MSAT) over North America are addressed. WARC-MOB-87, MSAT frequency co-ordination, frequency sharing and key Canadian domestic issues are discussed. Author

N88-25693*# Johns Hopkins Univ., Laurel, Md.
PROPAGATION EFFECTS BY ROADSIDE TREES MEASURED AT UHF AND L-BAND FOR MOBILE SATELLITE SYSTEMS
Julius Goldhirsh and Wolfhard J. Vogel (Texas Univ., Austin.) *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 87-94 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Propagation field tests were performed in Central Maryland and involved a helicopter and mobile van as the source and

receiving platforms, respectively. Tests were implemented at both UHF (870 MHz) and L-band (1.5 GHz) during a period in which the trees were in full blossom and contained maximum moisture. Cumulative fade distributions were determined from the data for various fixed elevation angles, side of the road driving, and road types for both worst and best case path geometries and for overall average road conditions. Author

N88-25694*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Electrical Engineering.
PROPAGATION MODELING FOR LAND MOBILE SATELLITE SYSTEMS
R. Michael Barts and Warren L. Stutzman *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 95-100 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

A simplified empirical model for predicting primary fade statistics for a vegetatively shadowed mobile satellite signal is presented, and predictions based on the model are presented using propagation parameter values from experimental data. Results from the empirical model are used to drive a propagation simulator to produce the secondary fade statistics of average fade duration. Author

N88-25695*# Michigan Technological Univ., Houghton. Dept. of Electrical Engineering.
ATTENUATED DIRECT AND SCATTERED WAVE PROPAGATION ON SIMULATED LAND MOBILE SATELLITE SERVICE PATHS IN THE PRESENCE OF TREES
Richard L. Campbell and Robert Estus *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 101-106 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Measurements were made of direct path with no trees, attenuated direct, and tree scattered signal levels at 1.3 GHz. Signals were received in two small groves of mixed hardwood trees. In the groves studied, average total signal levels were about 13 dB below adjacent no-trees locations, with attenuated direct signal levels about 14.6 dB below the no-trees case and scattered signals about 17.3 dB below the no-trees case. A simple model for land mobile satellite service (LMSS) propagation in groves of trees is proposed. The model assumes a constant scattered signal contribution at 17 dB below no-trees levels added to an attenuated direct signal which varies, depending on the number and density of trees in the direct path. When total signal levels are strong, the attenuated direct signal dominates. When total signal levels are more than 15 dB below no-trees levels, the scattered signals dominate. Author

N88-25696*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Electrical Engineering.
MOBILE SATELLITE PROPAGATION MEASUREMENTS AND MODELING: A REVIEW OF RESULTS FOR SYSTEMS ENGINEERS
Warren L. Stutzman, ed., R. Michael Barts, C. W. Bostian, J. S. Butterworth, Richard L. Campbell, Julius Goldhirsh, and Wolfhard J. Vogel (Texas Univ., Austin.) *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 107-117 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

An overview of Mobile Satellite Service (MSS) propagation measurements and modeling is intended as a summary of current results. While such research is on-going, the simple models presented here should be useful to systems engineers. A complete summary of propagation experiments with literature references is also included. Author

N88-25697*# Telecom Research Labs., Clayton (Australia).
PROPAGATION MEASUREMENTS FOR AN AUSTRALIAN LAND MOBILE SATELLITE SYSTEM
Anthony J. Bundrock and Robert Harvey *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 119-124 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Measurements of attenuation statistics using a helicopter and an instrumented van are discussed. Results are given for two different tree densities, for elevation angles of 30, 45 and 60 degrees and for frequencies of 893, 1550 and 2660 MHz. These results show that at 1550 MHz and 45 degrees elevation angle, attenuation values of 5.0 and 8.6 dB were exceeded 10 percent of the time for roadside tree densities of 35 percent and 85 percent respectively. Comparisons with other results made in the Northern Hemisphere are made and show general agreement. The implication of the measured values on system design are discussed, and it is shown that, for Australia, an adaptive margin allocation scheme would require an average margin of approximately 5 dB. Author

N88-25698*# Rockwell International Corp., Cedar Rapids, Iowa. Avionics Group.
LAND MOBILE SATELLITE PROPAGATION RESULTS
David C. Nicholas *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 125-131 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

During the Fall of 1987 a land mobile satellite demonstration using the MARECS B2 satellite at 26 degrees W was performed. While all the data have not been digested, some observations are in order. First, the system worked remarkably well for the margins indicated. Second, when the system worked poorly, the experimenters could almost always identify terrain or other obstacles causing blockage. Third, the forward link seems relatively more reliable than the return link, and occasional return link problems occured which have not been entirely explained. Author

N88-25699*# Colorado Univ., Boulder. Dept. of Electrical and Computer Engineering.
PROPAGATION EFFECTS ON SPREAD-SPECTRUM MOBILE SATELLITE SYSTEMS
Warren L. Flock and Ernest K. Smith *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 133-138 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

In contrast to the situation at L-band, wide bandwidths of 500 MHz or more have been allocated for mobile satellite service at frequencies between 20 and 50 GHz. These broad bandwidths are well suited for the use of spread-spectrum. Certain system considerations about the use of such high frequencies for mobile satellite service are mentioned first, and attention is then given to propagation effects on high-frequency broad-band systems. Attenuation due to rain is a constant at 20 to 50 MHz, but would not be a serious problem if outages occurring for one to three percent of the time, depending on location, are considered to be acceptable. Clear air absorption becomes a significant factor above 40 GHz, but should not exceed 2 dB at a 10 degree elevation angle and frequencies below 40 GHz. Spread-spectrum provides a form of frequency diversity that helps to minimize the effects of multipath. Author

N88-25700*# Institute for Telecommunication Sciences, Boulder, Colo.
MILTIPATH MEASUREMENTS FOR LAND MOBILE SATELLITE SERVICE USING GLOBAL POSITIONING SYSTEM SIGNALS
John J. Lemmon *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 139-144 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

A proposed multipath system for the land mobile satellite radio channel using the Global Positioning System (GPS) is presented. The measurement technique and equipment used to make multipath measurements on communications links are briefly described. The system configuration and performance specifications of the proposed measurement system are discussed. Author

N88-25701*# Communications Research Lab., Tokyo (Japan).
DEVELOPMENT OF A MOBILE SATELLITE COMMUNICATION UNIT
Ryutaro Suzuki, Tetsushi Ikegami, Naokazu Hamamoto, Tetsu Taguchi, Nobuhiro Endo, Osamu Yamamoto, and Osamu Ichiyoshi (Nippon Electric Co. Ltd., Yokohama, Japan) *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 147-153 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

A compact 210(W) x 280(H) x 330(D) mm mobile terminal capable of transmitting voice and data through L-band mobile satellites is described. The Voice Codec can convert an analog voice to or from digital codes at rates of 9.6, 8 and 4.8 kb/s by an MPC algorithm. The terminal functions with a single 12 V power supplied vehicle battery. The equipment can operate at any L-band frequency allocated for mobile uses in a full duplex mode and will soon be put into a field test via Japans's ETS-V satellite. Author

N88-25702*# Telesat Canada, Ottawa (Ontario). MSAT Project.
DEVELOPMENT OF THE NETWORK ARCHITECTURE OF THE CANADIAN MSAT SYSTEM
N. George Davies, Alireza Shoamanesh, and Victor C. M. Leung (Hong Kong Univ.) *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 155-161 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

A description is given of the present concept for the Canadian Mobile Satellite (MSAT) System and the development of the network architecture which will accommodate the planned family of three categories of service: a mobile radio service (MRS), a mobile telephone service (MTS), and a mobile data service (MDS). The MSAT satellite will have cross-strapped L-band and Ku-band transponders to provide communications services between L-band mobile terminals and fixed base stations supporting dispatcher-type MRS, gateway stations supporting MTS interconnections to the public telephone network, data hub stations supporting the MDS, and the network control center. The currently perceived centralized architecture with demand assignment multiple access for the circuit switched MRS, MTS and permanently assigned channels for the packet switched MDS is discussed. Author

N88-25703*# Telesat Canada, Ottawa (Ontario).
SYSTEM ARCHITECTURE FOR THE CANADIAN INTERIM MOBILE SATELLITE SYSTEM
M. Shariatmadar, K. Gordon, B. Skerry, H. ElDamhougy, and D. Bossler *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 163-169 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The system architecture for the Canadian Interim Mobile Satellite Service (IMSS) which is planned for commencement of commercial service in late 1989 is reviewed. The results of an associated field trial program which was carried out to determine the limits of coverage and the preliminary performance characteristics of the system are discussed. Author

N88-25704*# Racal Avionics Ltd., London (England).
DESIGN, DEVELOPMENT AND TRIALS OF AN AIRLINE PASSENGER TELEPHONE SYSTEM
Jim Schoenenberger and Roger McKinlay *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 171-176 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The design, development and trials of a satellite telephone system for airline passengers is described. The requirements for ground and space infrastructure are discussed and the aeronautical system is described. Design criteria for the antennas and avionic boxes are given and system operation and technical flight trial requirements are discussed, together with test methodology and development towards fully commercial trials. Finally, an indication of development requirements to achieve the desired aims of airline users is given. Author

N88-25705*# Communications Research Centre, Ottawa (Ontario). Mobile Satellite Program.
SATELLITE COMMUNICATIONS EXPERIMENT FOR THE ONTARIO AIR AMBULANCE SERVICE
John S. Butterworth *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 177-182 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

A satellite communications experiment was conducted to develop a reliable voice communications system between paramedics and doctors at certain larger medical centers. The experiment used INMARSAT's Atlantic Ocean Region satellite which provides coverage to the western border of Ontario. Forward downlink power from the satellite is in great demand, so two highly power-efficient modulation schemes were chosen for evaluation during the experiment. These were amplitude-companded single-sideband (ACSSB) and linear predictive coding in conjunction with DMSK modulation. Good performance with a signal to noise ratio of about 10 dB was demonstrated from many parts of the province with evevation angle to the satellite ranging from five to twenty degrees and with the aircraft both in-flight and on the runway. Author

N88-25706*# Rockwell International Corp., Cedar Rapids, Iowa.
LAND MOBILE SATELLITE DEMONSTRATION SYSTEM
Guy M. Gooch and David C. Nicholas *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 183-188 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

A land mobile satellite demonstration system is described. It ulilizes the INMARSAT MARECS B2 satellite at 26 degrees W. The system provides data transmission using a poll-response protocol with error detection and retransmission at 200 b/s rate. For most tests a 1.8 inch monopole antenna was used, along with a satellite EIRP normally used for four voice channels. A brief summary of the results are given and the overall system consisting of three elements in addition to the satellite (the mobile unit, the base station, and the office terminal and map display) is described. Throughput statistics from one trip are summarized. Author

N88-25707*# Hughes Aircraft Co., Los Angeles, Calif.
MOBILESTAR FIELD TEST PROGRAM
Wayne Rubow *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 189-194 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Various field tests were performed in order to gain practical experience and a broader understanding of mobile communications. The first phase consisted of CW propagation tests to develop firsthand experience of propagation phenomena. From this information, estimates of the feasibility and accuracy of power control were possible. The next phase tested the idea of power control. Equipment representative of that expected to be used in an actual mobile satellite communication system was assembled and tested under a variety of environments. Author

N88-25708*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE JPL MSAT MOBILE LABORATORY AND THE PILOT FIELD EXPERIMENTS
Jeff B. Berner and Richard F. Emerson *In its* Proceedings of the Mobile Satellite Conference May 1988 p 195-201 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

A Mobile Laboratory/Propagation Measurement Van (PMV) was developed to support the field experiments of the Mobile Satellite Experiment (MSAT-X) Project. This van was designed to provide flexibility, self-sufficiency and data acquisition to allow for both measurement of equipment performance and the mobile environment. The design philosophy and implementation of the PMV are described. The Pilot Field Experiments and an overall

description of the three experiments in which the PMV was used are described. Author

N88-25709*# Qualcomm, Inc., San Diego, Calif.
TECHNICAL CHARACTERISTICS OF THE OMNITRACS: THE FIRST OPERATION MOBILE Ku-BAND SATELLITE COMMUNICATIONS SYSTEM
Franklin P. Antonio, Klein S. Gilhousen, Irwin M. Jacobs, and Linday A. Weaver, Jr. *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 203-208 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The techinical characteristics of the OmniTRACS system are described. The system is the first operational mobile Ku-band satellite communications system and provides two-way message and position determination service to mobile terminals using existing Ku-band satellites. Interference to and from the system is minimized by the use of special spread-spectrum techniques, together with low power and low data rate transmissions. Author

N88-25710*# Communications Research Centre, Ottawa (Ontario).
AN ADAPTIVE ARRAY ANTENNA FOR MOBILE SATELLITE COMMUNICATIONS
Robert Milne *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 211-216 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The adaptive array is linearly polarized and consists essentially of a driven lambda/4 monopole surrounded by an array of parasitic elements all mounted on a ground plane of finite size. The parasitic elements are all connected to ground via pin diodes. By applying suitable bias voltages, the desired parasitic elements can be activated and made highly reflective. The directivity and pointing of the antenna beam can be controlled in both the azimuth and elevation planes using high speed digital switching techniques. The antenna RF losses are neglible and the maximum gain is close to the theoretical value determined by the effective aperture size. The antenna is compact, has a low profile, is inexpensive to manufacture and can handle high transmitter power. Author

N88-25711*# Ball Aerospace Systems Div., Broomfield, Colo.
MSAT MOBILE ELECTRONICALLY STEERED PHASED ARRAY ANTENNA DEVELOPMENT
Fred Schmidt *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 217-222 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The Mobile Satellite Experiment (MSAT-X) breadboard antenna design demonstrates the feasibility of using a phased array in a mobile satellite application. An electronically steerable phased array capable of tracking geosynchronous satellites from anywhere in the Continental United States has been developed. The design is reviewed along with the test data. Cost analysis are presented which indicate that this design can be produced at a cost of $1620 per antenna. Author

N88-25712*# Teledyne Ryan Electronics, San Diego, Calif.
MSAT-X ELECTRONICALLY STEERED PHASED ARRAY ANTENNA SYSTEM
H. H. Chung, W. Foy, G. Schaffner, W. Pagels, M. Vayner, J. Nelson, and S. Y. Peng *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 223-228 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

A low profile electronically steered phased array was successfully developed for the Mobile Satellite Experiment Program (MSAT-X). The newly invented cavity-backed printed crossed-slot was used as the radiating element. The choice of this element was based on its low elevation angle gain coverage and low profile. A nineteen-way radial type unequal power divider and eighteen three-bit diode phase shifters constitute the beamformer module which is used to scan the beams electronically. A complete hybrid mode pointing system was also developed. The major features of the antenna system are broad coverage, low profile, and fast acquisition and tracking performance, even under fading conditions. Excellent intersatellite isolation (better than 26 dB) was realized, which will provide good quality mobile satellite communication in the future. Author

N88-25713*# Teledyne Ryan Electronics, San Diego, Calif.
MSAT-X PHASED ARRAY ANTENNA ADAPTIONS TO AIRBORNE APPLICATIONS
C. Sparks, H. H. Chung, and S. Y. Peng *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 229-234 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The Mobile Satellite Experiment (MSAT-X) phased array antenna is being modified to meet future requirements. The proposed system consists of two high gain antennas mounted on each side of a fuselage, and a low gain antenna mounted on top of the fuselage. Each antenna is an electronically steered phased array based on the design of the MSAT-X antenna. A beamforming network is connected to the array elements via coaxial cables. It is essential that the proposed antenna system be able to provide an adequate communication link over the required space coverage, which is 360 degrees in azimuth and from 20 degrees below the horizon to the zenith in elevation. Alternative design concepts are suggested. Both open loop and closed loop backup capabilities are discussed. Typical antenna performance data are also included. Author

N88-25714*# Jet Propulsion Lab., California Inst. of Tech., Pasadena. Dept. of EE-Systems.
ADAPTIVE INTERFERENCE TECHNIQUES FOR MOBILE ANTENNAS
Lloyd J. Griffiths (University of Southern California, Los Angeles.) and E. Satorius *In its* Proceedings of the Mobile Satellite Conference May 1988 p 235-240 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The results of a study performed to investigate effective, low cost adaptive signal processing techniques for suppressing mutual satellite interference that can arise in a mobile satellite (MSAT) communication system are discussed. The study focused on the use of adaptive sidelobe cancelling as a method to overcome undesired interference caused by a multiplicity of satellite transmissions within the field of view of the ground station. Results are presented which show that the conventional sidelobe canceller produces undesired reduction of the useful signal. This effect is due to the presence of the useful component in the reference antenna element. An alternative structure, the generalized sidelobe canceller (GSC), has been proposed to overcome this difficulty. A preliminary investigation of possible implementations of the GSC was conducted. It was found that at most 8 bits would be required to implement the GSC processor under conditions in which the desired signal-to-interference ratio is 25 dB. Author

N88-25715*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE JPL MECHANICALLY STEERED ANTENNA
Jeff B. Berner and David J. Bell *In its* Proceedings of the Mobile Satellite Conference May 1988 p 241-247 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The Jet Propulsion Laboratory has designed and developed a mechanically steered antenna for tracking satellites in a mobile environment. This antenna was used to track an L-band beacon on the MARISAT satellite. A description of the antenna and the results of the satellite experiment are given. Author

N88-25716*# Illinois Univ., Urbana. Electromagnetics Lab.
SIMPLE, LOW-PROFILE, CIRCULARLY POLARIZED ARRAYS
Paul Mayes, James Drewniak, James Bowen, and James Gentle *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite

Conference May 1988 p 249-254 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

A low-profile, circularly polarized antenna can be made using an annular sector of strip conductor parallel to a closely spaced ground plane. This antenna has a very wide impedance bandwidth and is particularly well suited for use in series-fed arrays. Control of the excitation coefficients can be accomplished by a simple variation in the geometry of each element. Interconnection of the elements has been realized both in coaxial cable and in microstrip. Axial ratios less than 1 dB in the broadside direction are easily obtainable. Author

N88-25717*# Prodelin Corp., Conover, N.C.
OMNI-DIRECTIONAL L-BAND ANTENNA FOR MOBILE COMMUNICATIONS
C. S. Kim, N. Moldovan, and J. Kijesky *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 255-260 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The principle and design of an L-band omni-directional mobile communication antenna are discussed. The antenna is a circular wave guide aperture with hybrid circuits attached to higher order mode excitation. It produces polarized and symmetric two split beams in elevation. The circular waveguide is fed by eight probes with a 90 degree phase shift between their inputs. Radiation pattern characteristics are controlled by adjusting the aperture diameter and mode excitation. This antenna satisfies gain requirements as well as withstanding the harsh environment. Author

N88-25718*# Technology Group, Century City, Calif.
TRELLIS-CODED CPM FOR SATELLITE-BASED MOBILE COMMUNICATIONS
Farrokh Abrishamkar and Ezio Biglieri (California Univ., Los Angeles.) *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 263-270 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Digital transmission for satellite-based land mobile communications is discussed. To satisfy the power and bandwidth limitations imposed on such systems, a combination of trellis coding and continuous-phase modulated signals are considered. Some schemes based on this idea are presented, and their performance is analyzed by computer simulation. The results obtained show that a scheme based on directional detection and Viterbi decoding appears promising for practical applications. Author

N88-25719*# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. of Communication Technology.
INTERLEAVER DESIGN FOR TRELLIS-CODED DIFFERENTIAL 8-PSK MODULATION WITH NON-COHERENT DETECTION
Franz Edbauer *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 271-276 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The effect of finite interleaver size on bit error rate (BER) performance of coded 8-DPSK is determined by means of computer simulations. The losses evaluated in this way include the SNR degradation due to the timing and frequency errors of the symbol synchronizer and the automatic frequency control (AFC) of the receiver. BER measurements are presented using a conventional 2/3 rate convolutional 8-state trellis-code for typical Rayleigh and Rician fading channels. It is shown that for a Rician channel with a Rician parameter of 7 dB, a Doppler spread of 100 Hz and a data rate of 2400 bps, an interleaver with size 16 x 16 symbols performs nearly as well as a very large interleaver. It is also shown that for very fast Rayleigh channels, the BER-curves flatten out at large SNR. Author

N88-25720*# International Business Machines Corp., Rueschlikon (Switzerland).
CODES FOR QPSK MODULATION WITH INVARIANCE UNDER 90 DEGREES ROTATION
Gottfried Ungerboeck and Steven S. Pietrobon (South Australian Inst. of Tech., Adelaide.) *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 277-282 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The new rate 1/2 nonlinear convolutional codes for quadrature phase shift keying (QPSK) modulation allow the achievement of full 90 degree rotational invariance of coded QPSK signal sequences at no significant loss in real coding gains when compared to linear codes. For mobile communication systems operating in a fading environment with frequent periods of low signal-to-noise ratio and the possibility of losses of carrier phase synchronization in the receiver, the invariance to 90 degree ambiguous demodulation should be a significant advantage. Author

N88-25721*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TRELLIS-CODED MPSK MODULATION TECHNIQUES FOR MSAT-X(SUP)1
Dariush Divsalar and Marvin K. Simon *In its* Proceedings of the Mobile Satellite Conference May 1988 p 283-290 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Various trellis-coded modulated phase shift keying (MPSK) modulation techniques for transmitting 4.8 kbps over a 5 kHz RF channel are considered. The tradeoffs between coherent versus differentially coherent types of demodulation, and interleaving are discussed as well as optimum trellis-codes designed for fading channels. Simulation results are presented. Author

N88-25722*# Queens Univ., Kingston (Ontario). Dept. of Electrical Engineering.
MODULATION AND CODING FOR FAST FADING MOBILE SATELLITE COMMUNICATION CHANNELS
P. J. McLane, P. H. Wittke, W. S. Smith, A. Lee, P. K. M. Ho, and C. Loo (Department of Communications, Ottawa, Ontario) *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 291-296 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The performance of Gaussian baseband filtered minimum shift keying (GMSK) using differential detection in fast Rician fading, with a novel treatment of the inherent intersymbol interference (ISI) leading to an exact solution is discussed. Trellis-coded differentially coded phase shift keying (DPSK) with a convolutional interleaver is considered. The channel is the Rician Channel with the line-of-sight component subject to a lognormal transformation. Author

N88-25723*# Communications Research Centre, Ottawa (Ontario).
PERFORMANCE OF THE ICAO STANDARD CORE SERVICE MODULATION AND CODING TECHNIQUES
John Lodge and Michael Moher (Miller Communications Systems Ltd., Kanata, Ontario) *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 297-302 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Aviation binary phase shift keying (A-BPSK) is described and simulated performance results are given that demonstrate robust performance in the presence of hardlimiting amplifiers. The performance of coherently-detected A-BPSK with rate 1/2 convolutional coding are given. The performance loss due to the Rician fading was shown to be less than 1 dB over the simulated range. A partially coherent detection scheme that does not require carrier phase recovery was described. This scheme exhibits similiar performance to coherent detection, at high bit error rates, while it is superior at lower bit error rates. Author

N88-25724*# Hughes Aircraft Co., Los Angeles, Calif. Space and Communications Group.
COMPARISON OF CDMA AND FDMA FOR THE MOBILESTAR(SM) SYSTEM
I. M. Jacobs, K. S. Gilhousen, L. A. Weaver (Qualcomm, Inc., San Diego, Calif.), K. Renshaw, and T. Murphy *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 303-308 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Spread-spectrum code division multiple access (CDMA) and single channel per carrier frequency division multiple access (FDMA) systems are compared for spectrum efficiency. CDMA is shown to have greater maximum throughput than FDMA for the MobileStar(sm) system which uses digital voice activated carriers and directive circularly polarized satellite antennas. Author

N88-25725*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AN 8-DPSK TCM MODEM FOR MSAT-X
Thomas C. Jedrey, Norman E. Lay, and William Rafferty *In its* Proceedings of the Mobile Satellite Conference May 1988 p 311-316 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

This paper describes the real-time digital implementation of an 8-differentiated phase-shift keying (DPSK) trellis-coded modulation (TCM) modem for operation on an L-band, 5 kHz wide, land mobile satellite (LMS) channel. The modem architecture as well as some of the signal processing techniques employed in the modem to combat the LMS channel impairments are described, and the modem performance over the fading channel is presented. Author

N88-25726*# Harris Corp., Melbourne, Fla. Government Communications Systems Div.
DEVELOPMENT OF A CODED 16-ARY CPFSK COHERENT DEMODULATOR
Ken Clarke, Robert Davis, and Jim Roesch *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 317-322 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Theory and hardware are described for a proof-of-concept 16-ary continuous phase frequency shift keying (16-CPFSK) digital modem. The 16 frequencies are spaced every 1/16th baud rate for 2 bits/sec/Hz operation. Overall rate 3/4 convolutional coding is incorporated. The demodulator differs significantly from typical quadrature phase detector approaches in that phase is coherently measured by processing the baseband output of a frequency discriminator. Baud rate phase samples from the baseband processor are decoded to yield the original data stream. The method of encoding onto the 16-ary phase nodes, together with convolutional coding gain, results in near quad PSK (QPSK) performance. The modulated signal is of constant envelope; thus the power amplifier can be saturated for peak performance. The spectrum is inherently bandlimited and requires no RF filter. Author

N88-25727*# Rockwell International Corp., Cedar Rapids, Iowa. Avionics Group.
MODEM FOR THE LAND MOBILE SATELLITE CHANNEL
Steven J. Henely *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 323-328 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

This paper describes a modem which has been developed and implemented using a digital signal processor (DSP) for a land mobile satellite demonstration system. The requirements of this digital modem were determined by the characteristics of the land mobile satellite channel. This paper discusses the algorithms which implement the differentiated phase shift keying (DPSK) demodulator. An algorithm is included which estimates symbol timing independent of carrier phase without the use of a square-law nonlinearity. Author

N88-25728*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PILOT-AIDED MODULATION FOR NARROW-BAND SATELLITE COMMUNICATIONS
Gary J. Saulnier (Rensselaer Polytechnic Inst., Troy, N.Y.) and William Rafferty *In its* Proceedings of the Mobile Satellite Conference May 1988 p 329-336 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

This paper discusses a number of tone-aided modulation techniques which have been studied as part of the Mobile Satellite Experiment (MSAT-X) Program. In all instances tone(s) are inserted into data-free portions of the transmit spectrum and used by the receiver to sense the amplitude and frequency/phase distortions introduced by the channel. The receiver then uses this information in a feedforward manner to lessen the effect of the distortions on the data detection performance. Particular techniques discussed are the Tone Calibration Technique (TCT), the Dual Tone Calibrated Technique (DTCT), Transparent Tone-In-Band (TTIB), and Dual-Tone Single Sideband (DTSSB). Author

N88-25729*# Simon Fraser Univ., Burnaby (British Columbia). School of Engineering Science.
AN ERROR FLOOR IN TONE CALIBRATED TRANSMISSION
James K. Cavers *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 337-343 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Use of a low level pilot tone has been shown to eliminate the error floor in fading channels. This paper demonstrates that non-idealities in the receiver's pilot tone filter cause reappearance of the error floor. It also presents the bit error rate (BER) in closed form, in contrast to the multidimensional numerical integration of previous work. Author

N88-25730*# Canterbury Univ., Christchurch (New Zealand). Dept. of Electrical and Electronic Engineering.
EXTENDING THE IMPULSE RESPONSE IN ORDER TO REDUCE ERRORS DUE TO IMPULSE NOISE AND SIGNAL FADING
Joseph A. Webb, Andrew J. Rolls, and H. R. Sirisena *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 345-350 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

A finite impulse response (FIR) digital smearing filter was designed to produce maximum intersymbol interference and maximum extension of the impulse response of the signal in a noiseless binary channel. A matched FIR desmearing filter at the receiver then reduced the intersymbol interference to zero. Signal fades were simulated by means of 100 percent signal blockage in the channel. Smearing and desmearing filters of length 256, 512, and 1024 were used for these simulations. Results indicate that impulse response extension by means of bit smearing appears to be a useful technique for correcting errors due to impulse noise or signal fading in a binary channel. Author

N88-25731*# Institute for Telecommunication Sciences, Boulder, Colo.
ACSB: A MINIMUM PERFORMANCE ASSESSMENT
Lloyd Thomas Jones and William A. Kissick (National Bureau of Standards, Boulder, Colo.) *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 351-358 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Amplitude companded sideband (ACSB) is a new modulation technique which uses a much smaller channel width than does conventional frequency modulation (FM). Among the requirements of a mobile communications system is adequate speech intelligibility. This paper explores this aspect of minimum required performance. First, the basic principles of ACSB are described, with emphasis on those features that affect speech quality. Second, the appropriate performance measures for ACSB are reviewed.

Third, a subjective voice quality scoring method is used to determine the values of the performance measures that equate to the minimum level of intelligibility. It is assumed that the intelligibility of an FM system operating at 12 dB SINAD represents that minimum. It was determined that ACSB operating at 12 dB SINAD with an audio-to-pilot ratio of 10 dB provides approximately the same intelligibility as FM operating at 12 dB SINAD. Author

N88-25732*# Communications Research Centre, Ottawa (Ontario). Mobile Satellite Program.

A STUDY ON THE CO- AND ADJACENT CHANNEL PROTECTION REQUIREMENTS FOR MOBILE SATELLITE ACSSB MODULATION

John T. Sydor *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 359-364 (For primary document see N88-25680 19-32)

Avail: NTIS HC A23/MF A01 CSCL 17B

Samples of speech modulated by narrowband frequency modulation (NBFM) (cellular) and amplitude companded single sideband (ACSSB) radios were subjected to simulated co- and adjacent channel interference environments typical of proposed frequency division multiple access (FDMA) mobile satellite systems. These samples were then listened to by a group of evaluators whose subjective responses to the samples were used to produce a series of graphs showing the relationship between subjective acceptability, carrier to noise density (C/No), carrier to interference ratio (C/I), and frequency offset. The results show that in a mobile satellite environment, ACSSB deteriorates more slowly than NBFM. The co- and adjacent channel protection ratios for both modulation techniques were roughly the same, even though the mechanism for signal deterioration is different. Author

N88-25733*# Microtel Pacific Research Ltd., Burnaby (British Columbia).

A FRAMEWORK FOR IMPLEMENTING DATA SERVICES IN MULTI-SERVICE MOBILE SATELLITE SYSTEMS

Mohammed O. Ali, Victor C. M. Leung (Hong Kong Univ.), and Andrew I. Spolsky *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 367-372 (For primary document see N88-25680 19-32)

Avail: NTIS HC A23/MF A01 CSCL 17B

Mobile satellite systems being planned for introduction in the early 1990s are expected to be invariably of the multi-service type. Mobile Telephone Service (MTS), Mobile Radio Service (MRS), and Mobile Data Service (MDS) are the major classifications used to categorize the many user applications to be supported. The MTS and MRS services encompass circuit-switched voice communication applications, and may be efficiently implemented using a centralized Demand-Assigned Multiple Access (DAMA) scheme. Applications under the MDS category are, on the other hand, message-oriented and expected to vary widely in characteristics; from simplex mode short messaging applications to long duration, full-duplex interactive data communication and large file transfer applications. For some applications under this service category, the conventional circuit-based DAMA scheme may prove highly inefficient due to the long time required to set up and establish communication links relative to the actual message transmission time. It is proposed that by defining a set of basic bearer services to be supported in MDS and optimizing their transmission and access schemes independent of the MTS and MRS services, the MDS applications can be more efficiently integrated into the multi-service design of mobile satellite systems. Author

N88-25734*# Telesat Canada, Ottawa (Ontario).

L-BAND AND SHF MULTIPLE ACCESS SCHEMES FOR THE MSAT SYSTEM

Michael Razi, Alireza Shoamanesh, and Bahman Azarbar *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 373-379 (For primary document see N88-25680 19-32)

Avail: NTIS HC A23/MF A01 CSCL 17B

The first generation of the Canadian Mobile Satellite (MSAT) system, planned to be operational in the early 1990s, will provide voice and data services to land, aeronautical, and maritime mobile terminals within the Canadian land mass and its territorial waters. The system will be managed by a centralized Demand Assignment Multiple Access (DAMA) control system. Users will request a communication channel by communicating with the DAMA Control System (DCS) via the appropriate signalling channels. Several access techniques for both L-band and SHF signalling channels have been investigated. For the L-band, Slotted Aloha (SA) and Reservation Aloha (RA), combined with a token scheme, are discussed here. The results of Telesat studies to date indicate that SA, when combined with token scheme, provides the most efficient access and resource management tool in a mobile propagation environment. For SHF signalling channels, slim time division multiple access (TDMA) and SA have been considered as the most suitable candidate schemes. In view of the operational environment of the SHF links, provision of a very short channel access delay and a relatively high packet success rate are highly desirable. Studies carried out generally favor slim-TDMA as the most suitable approach for SHF signalling channels. Author

N88-25735*# Centro Studi e Laboratori Telecomunicazioni, Turin (Italy).

REARRANGEMENT PROCEDURES IN REGENERATIVE MULTIBEAMMOBILE COMMUNICATIONS SATELLITES WITH FREQUENCY REUSE

Gianni Colombo, Franco Settimo, and Antonio Vernucci *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 381-386 (For primary document see N88-25680 19-32)

Avail: NTIS HC A23/MF A01 CSCL 17B

After a short overview on the European tendencies about a Land Mobile Satellite Service, this paper describes an advanced system architecture, based on multiple spot-beams and on-board processing, capable of providing message and voice services over a wide European coverage, including some North-Africa and Middle-East countries. A remarkable problem associated with spot-beam configurations is the requirement for flexibility in the capacity offer to the various coverage areas. This means incorporating procedures for changing the on-board modulator-to-spot associations, respecting the constraints imposed by frequency reuse. After discussing the requirements of the rearrangement procedure, an on-purpose algorithm is presented. This paper is derived form work performed on contract to the European Space Agency (ESA). Author

N88-25736*# Bell Telephone Labs., Inc., Whippany, N. J. Cellular Telecommunications Lab.

DESIGN MOBILE SATELLITE SYSTEM ARCHITECTURE AS AN INTEGRAL PART OF THE CELLULAR ACCESS DIGITAL NETWORK

E. S. K. Chien, J. A. Marinho, and J. E. Russell, Sr. *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 387-394 (For primary document see N88-25680 19-32)

Avail: NTIS HC A23/MF A01 CSCL 17B

The Cellular Access Digital Network (CADN) is the access vehicle through which cellular technology is brought into the mainstream of the evolving integrated telecommunications network. Beyond the integrated end-to-end digital access and per call network services provisioning of the Integrated Services Digital Network (ISDN), the CADN engenders the added capability of mobility freedom via wireless access. One key element of the CADN network architecture is the standard user to network interface that is independent of RF transmission technology. Since the Mobile Satellite System (MSS) is envisioned to not only complement but also enhance the capabilities of the terrestrial cellular telecommunications network, compatibility and interoperability between terrestrial cellular and mobile satellite systems are vitally important to provide an integrated moving telecommunications network of the future. From a network standpoint, there exist very strong commonalities between the terrestrial cellular system and the mobile satellite system. Therefore,

the MSS architecture should be designed as an integral part of the CADN. This paper describes the concept of the CADN, the functional architecture of the MSS, and the user-network interface signaling protocols. Author

N88-25737*# International Telecommunications Satellite Organization, El Segundo, Calif.
AN ACCESS ALTERNATIVE FOR MOBILE SATELLITE NETWORKS
W. W. Wu *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 395-404 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Conceptually, this paper discusses strategies of digital satellite communication networks for a very large number of low density traffic stations. These stations can be either aeronautical, land mobile, or maritime. The techniques can be applied to international, domestic, regional, and special purpose satellite networks. The applications can be commercial, scientific, military, emergency, navigational or educational. The key strategy is the use of a non-orthogonal access method, which tolerates overlapping signals. With n being either time or frequency partitions, and with a single overlapping signal allowed, a low cost mobile satellite system can be designed with n squared (n squared + n + 1) number of terminals. Author

N88-25738*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AN OPERATIONAL OPEN-END FILE TRANSFER PROTOCOL FOR MOBILE SATELLITE COMMUNICATIONS
Charles Wang, Unjeng Cheng, and Tsun-Yee Yan *In its* Proceedings of the Mobile Satellite Conference May 1988 p 405-411 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

This paper describes an operational open-end file transfer protocol which includes the connecting procedure, data transfer, and relinquishment procedure for mobile satellite communications. The protocol makes use of the frame level and packet level formats of the X.25 standard for the data link layer and network layer, respectively. The structure of a testbed for experimental simulation of this protocol over a mobile fading channel is also introduced. Author

N88-25739*# University of Southern California, Los Angeles. Dept. of Electrical Engineering-System.
INTEGRATED VOICE/DATA PROTOCOLS FOR SATELLITE CHANNELS
Cheng-Shong Wu and Victor O. K. Li *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 413-422 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Several integrated voice/data protocols for satellite channels are studied. The system consists of two types of traffic: voice calls which are blocked-calls-cleared and the data packets which may be stored when no channel is available. The voice calls are operated under a demand assignment protocol. Three different data protocols for data packets are introduced. Under Random Access Data (RAD), the Aloha random access scheme is used. Due to the nature of random access, the channel utilization is low. Under Demand Assignment Data (DAD), a demand assignment protocol is used to improve channel utilization. Since a satellite channel has long propagation delay, DAD may perform worse than RAD. The two protocols are combined to obtain a new protocol called Hybrid Data (HD). The proposed protocols are fully distributed and no central controller is required. Numerical results show that HD enjoys a lower delay than DAD and provides a much higher channel capacity than RAD. The effects of fixed and movable boundaries are compared in partitioning the total frequency band to voice and data users. Author

N88-25740*# Techno-Sciences, Inc., Greenbelt, Md.
EVALUATION OF CDMA SYSTEM CAPACITY FOR MOBILE SATELLITE SYSTEM APPLICATIONS
Partrick O. Smith and Evaggelos A. Geraniotis (Maryland Univ., College Park.) *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 423-428 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

A specific Direct-Sequence/Pseudo-Noise (DS/PN Code-Division Multiple-Access (CDMA) mobile satellite system (MSAT) architecture is discussed. The performance of this system is evaluated in terms of the maximum number of active MSAT subscribers that can be supported at a given uncoded bit-error probability. The evaluation decouples the analysis of the multiple-access capability (i.e., the number of instantaneous user signals) from the analysis of the multiple-access mutliplier effect allowed by the use of CDMA with burst-modem operation. We combine the results of these two analyses and present numerical results for scenarios of interest to the mobile satellite system community. Author

N88-25741*# Spar Aerospace Ltd., Ste-Anne-de-Bellevue (Quebec). System Engineering.
CONSIDERATIONS FOR SPACECRAFT DESIGN FOR MSAT
Kunvana Hing and Harry J. Moody *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 431-435 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The paper describes the system design considerations and design activities performed at Spar Aerospace in the last 18 months in support of the development of a Canadian Mobile Communication Satellite (MSAT). Recent evolving international agreements and events of importance to MSAT are the emergence of the U.S. Operator and the Mobile WARC 1987. Their impacts on the system requirements and system design are discussed. Solutions to these new requirements are implemented into the 9 Beam baseline design. The system design and the parallel technology development permit the support of a commercial flight program. Author

N88-25742*# Spar Aerospace Ltd., Ste-Anne-de-Bellevue (Quebec). Antenna Development Engineering.
ANTENNA SYSTEM FOR MSAT MISSION
Ingmar Karlsson, Yves Patenaude, and Leora Stipelman *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 437-442 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Spar has evaluated and compared several antenna concepts for the North American Mobile Satellite. The paper describes some of the requirements and design considerations for the antennas and demonstrates the performance of antenna concepts that can meet them. Multiple beam reflector antennas are found to give best performance and much of the design effort has gone into the design of the primary feed radiators and beam forming networks to achieve efficient beams with good overlap and flexibility. Helices and cup dipole radiators have been breadboarded as feed element candidates and meausured results are presented. The studies and breadboard activities have made it possible to proceed with a flight program. Author

N88-25743*# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
ANTENNA TECHNOLOGY FOR ADVANCED MOBILE COMMUNICATION SYSTEMS
Emmanuel Rammos, Antoine Roederer, and Roger Rogard *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 443-448 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The onboard antenna front end is the key subsystem conditioning configuration and performance of mobile communication satellites. The objectives of this paper are to demonstrate this key role and to review L-band satellite antenna technology for earth coverage and regional applications. Multibeam arrays are first discussed, then unfurlable and inflatable reflector

antennas are described. These technologies are now qualified in Europe for future mobile systems, for which the optimum choice of antenna technology has been found to be the key to efficient use of spectrum and power resources. Author

N88-25744*# Hughes Aircraft Co., Los Angeles, Calif. Space and Communications Group.

FREQUENCY ADDRESSABLE BEAMS FOR LAND MOBILE COMMUNICATIONS

J. D. Thompson and G. G. DuBellay *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 449-458 (For primary document see N88-25680 19-32)

Avail: NTIS HC A23/MF A01 CSCL 17B

Satellites used for mobile communications need to serve large numbers of small, low cost terminals. The most important parameters affecting the capacity of such systems are the satellite equivalent isotropically radiated power (EIRP) and gain to noise temperature ratio (G/T) and available bandwidth. Satellites using frequency addressed beams provide high EIRP and G/T with high-gain antenna beams that also permit frequency reuse over the composite coverage area. Frequency addressing is easy to implement and compatible with low-cost terminals and offers higher capacity than alternative approaches. Author

N88-25745*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

LARGE ANTENNA EXPERIMENTS ABOARD THE SPACE SHUTTLE: APPLICATION OF NONUNIFORM SAMPLING TECHNIQUES

Y. RahmatSamii *In its* Proceedings of the Mobile Satellite Conference May 1988 p 459-464 (For primary document see N88-25680 19-32)

Avail: NTIS HC A23/MF A01 CSCL 17B

Future satellite communication and scientific spacecraft will utilize antennas with dimensions as large as 20 meters. In order to commercially use these large, low sidelobe and multiple beam antennas, a high level of confidence must be established as to their performance in the 0-g and space environment. Furthermore, it will be desirable to demonstrate the applicability of surface compensation techniques for slowly varying surface distortions which could result from thermal effects. An overview of recent advances in performing RF measurements on large antennas is presented with emphasis given to the application of a space based far-field range utilizing the Space Shuttle and the concept of a newly developed nonuniform sampling technique. Author

N88-25746*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

THE 15-METER ANTENNA PERFORMANCE OPTIMIZATION USING AN INTERDISCIPLINARY APPROACH

William L. Grantham, Lyle C. Schroeder, Marion C. Bailey, and Thomas G. Campbell *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 465-470 (For primary document see N88-25680 19-32)

Avail: NTIS HC A23/MF A01 CSCL 17B

A 15-meter diameter deployable antenna has been built and is being used as an experimental test system with which to develop interdisciplinary controls, structures, and electromagnetics technology for large space antennas. The program objective is to study interdisciplinary issues important in optimizing large space antenna performance for a variety of potential users. The 15-meter antenna utilizes a hoop column structural concept with a gold-plated molybdenum mesh reflector. One feature of the design is the use of adjustable control cables to improve the paraboloid reflector shape. Manual adjustment of the cords after initial deployment improved surface smoothness relative to the build accuracy from 0.140 in. RMS to 0.070 in. Preliminary structural dynamics tests and near-field electromagnetic tests were made. The antenna is now being modified for further testing. Modifications include addition of a precise motorized control cord adjustment system to make the reflector surface smoother and an adaptive feed for electronic compensation of reflector surface distortions. Although the previous test results show good agreement between calculated and measured values, additional work is needed to study modelling limits for each discipline, evaluate the potential of adaptive feed compensation, and study closed-loop control performance in a dynamic environment. Author

N88-25747*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

A MICROSTRIP ARRAY FEED FOR MSAT SPACECRAFT REFLECTOR ANTENNA

John Huang *In its* Proceedings of the Mobile Satellite Conference May 1988 p 471-476 (For primary document see N88-25680 19-32)

Avail: NTIS HC A23/MF A01 CSCL 17B

An L-band circularly polarized microstrip array antenna with relatively wide bandwidth has been developed. The array has seven subarrays which form a single cluster as part of a large overlapping cluster reflector feed array. Each of the seven subarrays consists of four uniquely arranged linearly polarized microstrip elements. A 7.5 percent impedance (VSWR less than 1.5) as well as axial ratio (less than 1 dB) bandwidths have been achieved by employing a relatively thick honeycomb substrate with special impedance matching feed probes. Author

N88-25748*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

TECHNOLOGIES FOR ANTENNA SHAPE AND VIBRATION CONTROL

Edward Mettler, Robert Scheid, and Daniel Eldred *In its* Proceedings of the Mobile Satellite Conference May 1988 p 477-482 (For primary document see N88-25680 19-32)

Avail: NTIS HC A23/MF A01 CSCL 17B

This paper describes the application of advanced control methods and techniques to the second- and third-generation mobile satellite (MSAT) configurations having wrap-rib offset feed construction. The technologies are generically applicable to other designs such as hoop-column and other elastically deformable non-rigid structures. The focus of the discussion is on reflector shape determination and control, dynamics identification, and pointing jitter suppression. Author

N88-25749*# California Univ., Santa Barbara. Dept. of Electrical and Computer Engineering.

SPEECH CODING AT 4800 bps FOR MOBILE SATELLITE COMMUNICATIONS

Allen Gersho, Wai-Yip Chan, Grant Davidson, Juin-Hwey Chen, and Mei Yong *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 485-490 (For primary document see N88-25680 19-32)

Avail: NTIS HC A23/MF A01 CSCL 17B

A speech compression project has recently been completed to develop a speech coding algorithm suitable for operation in a mobile satellite environment aimed at providing telephone quality natural speech at 4.8 kbps. The work has resulted in two alternative techniques which achieve reasonably good communications quality at 4.8 kbps while tolerating vehicle noise and rather severe channel impairments. The algorithms are embodied in a compact self-contained prototype consisting of two AT and T 32-bit floating-point DSP32 digital signal processors (DSP). A Motorola 68HC11 microcomputer chip serves as the board controller and interface handler. On a wirewrapped card, the prototype's circuit footprint amounts to only 200 sq cm, and consumes about 9 watts of power. Author

N88-25750*# Department of Defense, Fort Meade, Md.

A 4.8 kbps CODE-EXCITED LINEAR PREDICTIVE CODER

Thomas E. Tremain, Joseph P. Campbell, Jr., and Vanoy C. Welch *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 491-496 (For primary document see N88-25680 19-32)

Avail: NTIS HC A23/MF A01 CSCL 17B

A secure voice system STU-3 capable of providing end-to-end secure voice communications (1984) was developed. The terminal for the new system will be built around the standard LPC-10 voice

processor algorithm. The performance of the present STU-3 processor is considered to be good, its response to nonspeech sounds such as whistles, coughs and impulse-like noises may not be completely acceptable. Speech in noisy environments also causes problems with the LPC-10 voice algorithm. In addition, there is always a demand for something better. It is hoped that LPC-10's 2.4 kbps voice performance will be complemented with a very high quality speech coder operating at a higher data rate. This new coder is one of a number of candidate algorithms being considered for an upgraded version of the STU-3 in late 1989. The problems of designing a code-excited linear predictive (CELP) coder to provide very high quality speech at a 4.8 kbps data rate that can be implemented on today's hardware are considered. Author

N88-25751*# Carleton Univ., Ottawa (Ontario). Dept. of Systems and Computer Engineering.
REAL-TIME SPEECH ENCODING BASED ON CODE-EXCITED LINEAR PREDICTION (CELP)
Wilfrid P. LeBlanc and S. A. Mahmoud *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference 497-502 (SEE N88-25680 19-32) May 1988 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

This paper reports on the work proceeding with regard to the development of a real-time voice codec for the terrestrial and satellite mobile radio environments. The codec is based on a complexity reduced version of code-excited linear prediction (CELP). The codebook search complexity was reduced to only 0.5 million floating point operations per second (MFLOPS) while maintaining excellent speech quality. Novel methods to quantize the residual and the long and short term model filters are presented. Author

N88-25752*# Massachusetts Inst. of Tech., Lexington. Speech Systems Technology.
SINUSOIDAL TRANSFORM CODING
Robert J. McAulay and Thomas F. Quatieri *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 503-508 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

It has been shown that an analysis/synthesis system based on a sinusoidal representation of speech leads to synthetic speech that is essentially perceptually indistinguishable from the original. Strategies for coding the amplitudes, frequencies and phases of the sine waves have been developed that have led to a multirate coder operating at rates from 2400 to 9600 bps. The encoded speech is highly intelligible at all rates with a uniformly improving quality as the data rate is increased. A real-time fixed-point implementation has been developed using two ADSP2100 DSP chips. The methods used for coding and quantizing the sine-wave parameters for operation at the various frame rates are described. Author

N88-25753*# Georgia Inst. of Tech., Atlanta. Digital Signal Processing Lab.
THE DESIGN AND PERFORMANCE OF A REAL-TIME SELF EXCITED VOCODER
Richard C. Rose, T. P. Barnwell, III, and S. McGrath *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 509-514 (For primary document see N88-25680 19-32)
(Contract JPL-957074)
Avail: NTIS HC A23/MF A01 CSCL 17B

This paper is concerned with a generic class of predictive speech coders that includes the newly proposed Self Excited Vocoder (SEV) and the well known Code-Excited Linear Predictive Coder (CELPC). All members of this class form an excitation sequence for a linear predictive model filter using the same general model for the excitation signal. The general excitation model is based on a block coding technique where each sequence is drawn from an ensemble of sequences. This paper reports on two developments related to this general model. The first development is a new type of excitation ensemble that can in general be populated by many different types of sequences. The second development is a means of populating this new type of ensemble based on a vector quantizer design procedure using a new distortion measure. Author

N88-25754*# Bell Telephone Labs., Inc., Murray Hill, N. J.
ROBUST VECTOR QUANTIZATION FOR NOISY CHANNELS
J. R. B. DeMarca, N. Farvardin (Maryland Univ., College Park.), N. S. Jayant, and Y. Shoham *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 515-520 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The paper briefly discusses techniques for making vector quantizers more tolerant to tranmsission errors. Two algorithms are presented for obtaining an efficient binary word assignment to the vector quantizer codewords without increasing the transmission rate. It is shown that about 4.5 dB gain over random assignment can be achieved with these algorithms. It is also proposed to reduce the effects of error propagation in vector-predictive quantizers by appropriately constraining the response of the predictive loop. The constrained system is shown to have about 4 dB of SNR gain over an unconstrained system in a noisy channel, with a small loss of clean-channel performance. Author

N88-25755*# Aeronautical Radio, Inc., Annapolis, Md. AvSat Program.
DEVELOPMENT OF AN 8000 bps VOICE CODEC FOR AVSAT
Joseph F. Clark *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 521-526 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Air-mobile speech communication applications share robustness and noise immunity requirements with other mobile applications. The quality requirements are stringent, especially in the cockpit where air safety is involved. Based on these considerations, a decision was made to test an intermediate data rate such as 8.0 and 9.6 kb/s as proven technologies. A number of vocoders and codec technologies were investigated at rates ranging from 2.4 kb/s up to and including 9.6 kb/s. The proven vocoders operating at 2.4 and 4.8 kb/s lacked the noise immunity or the robustness to operate reliably in a cabin noise environment. One very attractive alternative approach was Spectrally Encoded Residual Excited LPC (SE-RELP) which is used in a multi-rate voice processor (MRP) developed at the Naval Research Lab (NRL). The MRP uses SE-RELP at rates of 9.6 and 16 kb/s. The 9.6 kb/s rate can be lowered to 8.0 kb/s without loss of information by modifying the frame. An 8.0 kb/s vocoder was developed using SE-RELP as a demonstrator and testbed. This demonstrator is implemented in real time using two Compaq 2 portable computers, each equipped with an ARIEL DSP016 Data Acquisition Processor. Author

N88-25756*# Bell Telephone Labs., Inc., Naperville, Ill.
ANALYSIS AND IMPROVEMENT OF THE VECTOR QUANTIZATION IN SELP (STOCHASTICALLY EXCITED LINEAR PREDICTION)
W. B. Kleijn, D. J. Krasinski, and R. H. Ketchum *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 527-532 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

The Stochastically Excited Linear Prediction (SELP) algorithm is described as a speech coding method employing a two-stage vector quantization. The first stage uses an adaptive codebook which efficiently encodes the periodicity of voiced speech, and the second stage uses a stochastic codebook to encode the remainder of the excitation signal. The adaptive codebook performs well when the pitch period of the speech signal is larger than the frame size. An extension is introduced, which increases its performance for the case that the frame size is longer than the pitch period. The performance of the stochastic stage, which improves with frame length, is shown to be best in those sections of the speech signal where a high level of short-term correlations

is present. It can be concluded that the SELP algorithm performs best during voiced speech where the pitch period is longer than the frame length. Author

N88-25757*# Forest Service, Boise, Idaho. Advanced Electronics Group.
MOBILE SATELLITE COMMUNICATIONS IN THE FOREST SERVICE
John R. Warren *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 535-537 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

There are usually some places within a forest that do not have adequate communication coverage due to line-of-sight or other reasons. These areas are generally known by the foresters and radio technicians and allowances are made for that when working or traveling in those areas. However, when wildfire or other emergencies occur, communications are vital because wildfires can require hundreds of firefighters and cover thousands of acres. During these emergency operations, the existing communications are not adequate and complete radio systems are moved into the area for the conduct of fire communications. Incident command posts (ICPs) and fire camps are set up in remote locations and there is constant need for communications in the fire area and to agency headquarters and dispatch offices. Mobile satellite communications would be an ideal supplement to the Forest Service's current communications system in aiding forest fire control activities. Author

N88-25758*# Transit Communications, Inc., Pasadena, Calif.
MOBILE SATELLITE SERVICE IN THE UNITED STATES
Carson E. Agnew, Jai Bhagat, Edwin A. Hopper, John D. Kiesling, Michael L. Exner, Lawrence Melillo, Gary K. Noreen, and Billy J. Parrott (Satellite Mobile Telephone Co.) *In* Jet Propulsion Lab., Proceedings of the Mobile Satellite Conference May 1988 p 539-544 (For primary document see N88-25680 19-32)
Avail: NTIS HC A23/MF A01 CSCL 17B

Mobile satellite service (MSS) has been under development in the United States for more than two decades. The service will soon be provided on a commercial basis by a consortium of eight U.S. companies called the American Mobile Satellite Consortium (AMSC). AMSC will build a three-satellite MSS system that will offer superior performance, reliability and cost effectiveness for organizations requiring mobile communications across the U.S. The development and operation of MSS in North America is being coordinated with Telesat Canada and Mexico. AMSC expects NASA to provide launch services in exchange for capacity on the first AMSC satellite for MSAT-X activities and for government demonstrations. Author

N88-25759# Oak Ridge National Lab., Tenn.
THEORETICAL STUDY OF THE FOLDED WAVEGUIDE
G. L. Chen, T. L. Owens, and J. H. Whealton Jan. 1988 21 p
(Contract DE-AC05-84OR-21400)
(DE88-007877; ORNL/TM-10669) Avail: NTIS HC A03/MF A01

A Three-Dimensional (3-D) algorithm has been applied to solving Maxwell's equations for the analysis of folded waveguides used for fusion plasma heating at the ion cyclotron resonance frequency. A rigorous analysis of the magnetic field structure in the folded waveguide is presented. The results are compared to experimenntal measurements. Optimum conditions for the folded waveguide are discussed. DOE

N88-25760# Lawrence Livermore National Lab., Calif.
EVALUATION OF VERTICAL MONOPOLE ANTENNAS WITH ELEVATED RADIALS
J. K. Breakall and A. M. Christman Mar. 1988 193 p
(Contract W-7405-eng-48)
(DE88-008339; UCRL-21034) Avail: NTIS HC A09/MF A01

The Numerical Electromagnetics Code (NEC) was used to model a 32-foot vertical radiator operating over a variety of ground systems at several frequencies throughout the HF band. Recent work performed at LLNL indicated that superior performance could be achieved from a vertical monopole by elevating the radiator a short distance above the surface of the earth, when used in conjunction with a ground system composed of 4 elevated horizontal radials. Field tests were performed on several elevated-radial configurations as well as conventional ground-mounted vertical antennas using up to 120 radials in an attempt to confirm this hyporthesis. The results of field-strength and input-impedance measurements are contained herein. DOE

N88-25761# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
GRAVITATION AND POLARIZATION PROPERTIES OF ELECTROMAGNETIC FIELD
J. Loeffelholz and A. Pestov 1987 6 p In RUSSIAN; ENGLISH summary
(DE88-702166; JINR-R-2-87-503) Avail: NTIS (US Sales Only) HC A02/MF A01

It is shown that when an electromagnetic field is in a given gravitational field, the invariance of gravitational potentials under spatial reflections leads to electromagnetic field having two independent polarizations. A general comment is given on the energy of the gravitational field. DOE

N88-25762*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ACTIVE FEED ARRAY COMPENSATION FOR REFLECTOR ANTENNA SURFACE DISTORTIONS Ph.D. Thesis - Akron Univ., Ohio
Roberto J. Acosta Jun. 1988 177 p
(NASA-TM-100826; E-4015; NAS 1.15:100826) Avail: NTIS HC A09/MF A01 CSCL 20N

The feasibility of electromagnetic compensation for reflector antenna surface distortions is investigated. The performance characteristics of large satellite communication reflector antenna systems degrade as the reflector surface distorts, mainly due to thermal effects from solar radiation. The technique developed can be used to maintain the antenna boresight directivity and sidelobe level independent of thermal effects on the reflector surface. With the advent of monolithic microwave integrated circuits (MMIC), a greater flexibility in array fed reflector antenna systems can be achieved. MMIC arrays provide independent control of amplitude and phase for each of the many radiating elements in the feed array. By assuming a known surface distortion profile, a simulation study is carried out to examine the antenna performance as a function of feed array size and number of elements. Results indicate that the compensation technique can effectively control boresight directivity and sidelobe level under peak surface distortion in the order of tenth of a wavelength. Author

N88-25763 British Broadcasting Corp., Kingswood (England). Engineering Div.
DIGITAL TELEVISION ROUTING SYSTEMS: A SURVEY OF OPTICAL AND ELECTRICAL TECHNIQUES
R. P. Marsden, J. T. Zubrzycki, and J. P. Willson Mar. 1988 36 p
(BBC-RD-1988/3) Avail: Issuing Activity

The requirements for a digital video routing system for a studio center are reviewed. A large routing system capable of interconnecting more then 100 sources and 100 destinations is required. The options are described and compared. The high bit rate of digital video is well suited to optical fiber systems, but there are no suitable optical switches. Consequently, an optical system based on a passive star network is recommended. Time division and optical wavelength division multiplexing is used to achieve the required capacity. The system would be based on components now being developed for telecommunications networks. So strong are the advantages of the recommended system that even if optical switching were to become practical the passive star network would probably still be preferred.
Author

N88-25764# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
MINI-STATION FOR VHF RECEPTION: ARGOS SYSTEM SIMPLIFIED DESCRIPTION
Jean-Paul Dubut, Manoel Joseane MafradeCarvalho, Marcos Aurelio FerreiradosSantos, and Zurbaran deBritoPereira May 1988 17 p In PORTUGUESE; ENGLISH summary
(INPE-4551-NTE/279) Avail: NTIS HC A03/MF A01

Described briefly is the VHF Reception Station Argos System, which was developed to receive, identify and process ambiental data transmitted by TIROS N/NOAA satellites. The station includes a VHF bifrequency receiver, a synchronizer, and a commercial microcomputer with printer. Techniques of coherent reception are used for demodulation of messages received; recovered data are presented on a screen, printed, or recorded on floppy discs for future use. Author

N88-25795# Sandia National Labs., Albuquerque, N. Mex.
HIGH SPEED OPTO-ISOLATOR FOR RADAR APPLICATIONS
J. P. Anthes, P. Garcia, K. Y. Lau, and I. Ury (Ortel Corp., Alhambra, Calif.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 97-99 Previously announced as N87-18714 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25801# IBM Watson Research Center, Yorktown Heights, N.Y.
MESFET COMPATIBLE IMSM DETECTORS
D. L. Rogers *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 116-120 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25816# Texas A&M Univ., College Station. Dept. of Electrical Engineering.
RADAR AND EW APPLICATIONS OF MULTI-GIGAHERTZ OPTICAL COMPONENTS AND SYSTEMS
Henry F. Taylor *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 170-172 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25817# Hughes Research Labs., Malibu, Calif.
CHARACTERISTICS AND APPLICATION OF WIDEBAND GUIDED-WAVE DEVICES
C. M. Gee, G. D. Thurmond, and H. W. Yen *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 173-175 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-26054# International Maritime Satellite Organization, London (England).
SATELLITES AT SEA
Keith Thacker *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 273-279 (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N88-25765# Optical Society of America, Washington, D. C.
ORGANIZATION OF A TOPICAL MEETING ON PICOSECOND ELECTRONICS AND OPTOELECTRONICS Final Report
J. W. Quinn 1987 211 p Meeting held in Incline Village, Nev., 14-16 Jan. 1987
(Grant N00014-87-G-0050)
(AD-A187136) Avail: NTIS HC A10/MF A01 CSCL 09C

Topics addressed include: optoelectronic devices; semiconductor device physics; electronic devices; cryo-electronics; device fabrication technology; device characterization; and circuits and signal processing. For individual titles, see N88-25766 through N88-25824.

N88-25766# Bell Telephone Labs., Inc., Murray Hill, N. J.
A NON-CONTACT PICOSECOND PROBER FOR INTEGRATED CIRCUIT TESTING
J. A. Valdmanis and S. S. Pei *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 4-6 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

A noncontact substrate-independent integrated-circuit prober, based on electro-optic sampling, for internal node characterization of picosecond electrical waveforms at the wafer level is described. Author

N88-25767# Stanford Univ., Calif. E. L. Ginston Lab.
PICOSECOND SAMPLING OF INTEGRATED CIRCUITS
M. J. W. Rodwell, K. J. Weingarten, and D. M. Bloom *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 7-9 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Electro-optic sampling provides wide bandwidth measurements of the internal voltage of GaAs integrated circuits. Limitations to bandwidth and sensitivity are discussed, and recent results are presented. Author

N88-25768# International Business Machines Corp., Yorktown Heights, N. Y. Watson Research Center.
PICOSECOND ELECTRICAL PULSES FOR VLSI ELECTRONICS CHARACTERIZATION
J.-M. Halbout, P. G. May, M. B. Ketchen, G. P. Li, C. C. Chi, M. Scheuermann, and M. Smyth *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 10-11 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Picosecond electrical pulses are photoconductively generated and characterized on structures and materials compatible with silicon VLSI electronics. Author

N88-25769# Bell Telephone Labs., Inc., Holmdel, N. J.
ELECTRO-OPTIC SAMPLING OF HIGH-SPEED, InP-BASED INTEGRATED CIRCUITS
J. M. Wiesenfeld, R. S. Tucker, A. Antreasyan, C. A. Burrus, and A. J. Taylor (Los Alamos National Lab., N. Mex.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 12-14 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Multigigahertz waveforms in an InGaAs/InP MISFET inverter circuit were sampled noninvasively using pulses from a

gain-switched InGaAsP laser. Propagation delays of 21 ps per MISFET stage were measured. Author

N88-25770# Bell Telephone Labs., Inc., Murray Hill, N. J.
MOLECULAR BEAM EPITAXY (MBE) FOR HIGH SPEED DEVICES **c76**
A. Y. Cho *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 16-18 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Recent development in molecular bean epitaxy pushes the frontier of devices to the ultimate imagination of device physicists and engineers. High-speed devices prepared with epitaxial superlattice structure or multiquantum wells and pseudomorphic strained layers are discussed. Author

N88-25771# Bell Telephone Labs., Inc., Murray Hill, N. J.
MULTIGIGAHERTZ LOGIC BASED ON InP-MISFET's EXHIBITING EXTREMELY HIGH TRANSCONDUCTANCE **c76**
A. Antreasyan, P. A. Garbinski, V. D. Mattera, Jr., and H. Temkin *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 19-21 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

High-speed logic at 5.0 GHz based on an enhanced mode InP metal-insulator-semiconductor field-effect transistor having a propagation delay of 25 ps/stage and transconductances of 320 mS/mm for a gate length of 1 micron is reported. These measurements are the smallest propagation delay and the highest transconductance measured with a field-effect transistor on an InP substrate. Author

N88-25772# Lawrence Livermore National Lab., Calif.
AN OPTICALLY STROBED SAMPLE AND HOLD CIRCUIT
Chuck McConaghy *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 22-24 (For primary document see N88-25765 19-33)
(Contract W-7405-eng-48)
Avail: NTIS HC A10/MF A01 CSCL 09C

A GaAs sample and hold circuit with 10 ps aperture time and 1 microsec hold time was built and used to sample single shot signals. Author

N88-25773# Arizona Univ., Tucson. Optical Sciences Center.
HIGH-SPEED OPTICAL LOGIC USING GaAs
H. M. Gibbs, N. Peyghambarian, Y. H. Lee, J. L. Jewell, A. Migus, A. Antonetti, D. Hulin, and A. Mysyrowicz (Ecole Normale Superieure, Paris, France) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 25-27 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

The status of bulk-GaAs nonlinear etalons and their application to high-speed optical logic are summarized. Several characteristics are of particular importance: time to make a logic decision; time required for the device to recover and be ready to make the next decision; energy required per logic decision; and ability to switch the next device or several devices. Author

N88-25774# Naval Research Lab., Washington, D.C.
MILLIMETER-WAVE INTEGRATED CIRCUITS
Barry E. Spielman *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 30-32 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

The technical issues, current research focal points, progress, and trends associated with GaAs and InP based monolithic millimeter-wave integrated circuit technology are summarized. Author

N88-25775# Varian Associates, Palo Alto, Calif.
ENHANCED PERFORMANCE ULTRABROADBAND DISTRIBUTED AMPLIFIERS
George A. Zdasiuk, M. Riaziat, Ross A. LaRue, C. Yuen, and Steve G. Bandy *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 33-36 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

High-gain 2 to 20 GHz monolithic GaAs distributed amplifiers utilizing circuit approaches such as cascade-connected FETs and coplanar waveguide transmission lines are described. Preliminary results on a HEMT-based amplifier are also presented. Author

N88-25776# TRW Electronic Systems Group, Redondo Beach, Calif.
HIGH PERFORMANCE QUARTER-MICRON-GATE MODFETs
John J. Berenz *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 37-39 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

The latest results obtained with high performance quarter-micron-gate MODFETs used in RF applications are summarized. Results for both AlGaAs/GaAs and AlGaAs/InGaAs heterostructures are presented and compared. A projection of future performance achievements is given bases on anticipated improvements in materials and farication technology. Author

N88-25777# Massachusetts Univ., Amherst. Dept. of Electrical and Computer Engineering.
PICOSECOND PHOTOCONDUCTIVE TRANSCIEVERS
Alfred P. DeFonzo, Charles R. Lutz, and Madhuri Jarwala *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 40-42 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

The results of a study of picosecond electromagnetic transients generated and detected by photoconductivity in ion bombarded SOS, radiated, and received by tapered slot traveling wave antennas. Author

N88-25778# IBM Watson Research Center, Yorktown Heights, N.Y.
PHOTOCONDUCTIVE GENERATION OF SUB-PICOSECOND ELECTRICAL PULSES AND THEIR MEASUREMENT APPLICATIONS
D. Grischkowsky, C.-C. Chi, I. N. Duling, III, W. J. Gallagher, N. J. Halas (Bryn Mawr Coll., Pa.), J.-M. Halbout, and M. B. Ketchen *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 44-45 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Experimental and theoretical results exploring the fundamental limits to the generation of ultrashort electrical pulses via photoconductive switching are discussed. Measurement applications demonstrating tetrahertz spectroscopy, and subpicosecond electronics with the subpicosecond electrical pulses are presented. Author

N88-25779# Fujitsu Ltd., Atsugi (Japan).
PROGRESS AND CHALLENGES IN HEMT LSI TECHNOLOGY **c76**
Masayuki Abe, Takashi Mimura, Kazuo Kondo, and Masaaki Kobayashi *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 46-48 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

A high electron mobility transistor is a promising device for ultrahigh speed LSI/VLSI, especially operating at 77 K. Recent progress and technical challenges in HEMT LSI technology are discussed. Author

N88-25780# Rochester Univ., N. Y. Dept. of Electrical Engineering.
PICOSECOND SWITCHING IN JOSEPHSON TUNNEL JUNCTIONS **c76**
R. Sobolewski, D. R. Dykaar, T. Y. Hsiang, and G. A. Mourou *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 49-51 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
A superconducting electro-optic sampler was developed and used to probe the switching of a 30 x 30 micron Josephson tunnel junction. Author

N88-25781# Rochester Univ., N. Y. Lab. for Laser Energetics.
HIGH SPEED, HIGH REPETITION RATE, HIGH VOLTAGE PHOTOCONDUCTIVE SWITCHING
William R. Donaldson *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 54-56 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
Robust silicon photoconductive switches which were operated for several million shots at 1 kHz switching 10 kV in 100 ps without failure are described. The switches are characterized to maintain the photoconductive state. Author

N88-25782# Maryland Univ., College Park. Dept. of Electrical Engineering.
GENERATION AND FORMING OF ULTRASHORT HIGH VOLTAGE PULSES
Hrayr A. Sayadian, S. T. Feng, J. Goldhar, and Chi H. Lee *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 57-59 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
Picosecond multikilovolt pulses are generated using coaxial, microstrip, and coplanar pulse forming networks. A longitudinal Pockels effect is used to monitor the ultrafast pulses. Author

N88-25783# Maryland Univ., College Park. Dept. of Electrical Engineering.
GRAPHITE AS A PICOSECOND LASER ACTIVATED OPENING SWITCH
E. A. Chauchard, Chi H. Lee, C. Y. Huang, and A. M. Malvezzi (Harvard Univ., Cambridge, Mass.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 60-62 Previously announced as N87-21251 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
Highly Oriented Pyrolytic Graphite exhibiting a high conductivity in the dark and a high resistivity when illuminated by intense laser light was used as an opening switch. Author

N88-25784# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Applied Physics.
A SIMPLE TECHNIQUE TO GENERATE OR GATE MICROWAVE PULSES WITH PICOSECOND SPEEDS
W. Margulis, V. Grivitskas, E. Adomaitis, Z. Dobrovolskis, and A. Krotkus (Academy of Sciences of the Lithuanian SSR, Vilnius.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 63-65 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
A simple ultrafast optoelectric arrangement is described, enabling switching a number of cycles from a microwave generator, or shaping a microwave pulse with picosecond speed. Author

N88-25785# Texas Univ., Austin. Dept. of Electrical and Computer Engineering.
A PROPOSED QUANTUM WELL INJECTION TRANSIT TIME DEVICE (QWITT)
Vijay P. Kesan, Dean P. Neikirk, and Ben G. Streetman *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 66-68 (For primary document see N88-25765 19-33)
(Contract F49620-86-C-0045)
Avail: NTIS HC A10/MF A01 CSCL 09C
A transit time device that uses resonant tunneling through a quantum well is proposed and analyzed. It permits varying injection phase delays, with a wide frequency range of operation and low noise performance. It also promotes better output power than quantum-well oscillators. Author

N88-25786# Cornell Univ., Ithaca, N.Y. School of Electrical Engineering.
MODULATION EFFICIENCY LIMITED HIGH FREQUENCY PERFORMANCE OF THE MODFET
M. C. Foisy, J. C. Huang (Cornell Univ., New York, N.Y.), P. J. Tasker, and L. F. Eastman *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 69-71 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
Inefficient charge control is a primary degrading mechanism in high frequency MODFET operation. Numerical simulations illuminate the ramifications of varying each epilayer design parameter. Author

N88-25787# Illinois Univ., Urbana. Coordinated Science Lab.
CHARACTERISTICS OF SHIELDED MICROSTRIP LINES ON GaAs-Si AT MILLIMETER-WAVE FREQUENCIES
M. I. Aksun and H. Morkoc *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 72-75 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
GaAs on Si has attracted a great deal of interest. This is in part due to its potential use for microwave monolithic integration. The first theoretical study of dielectric losses of this composite material is present. Author

N88-25788# IBM Watson Research Center, Yorktown Heights, N.Y.
NONEQUILIBRIUM PHONONS AND DISORDER IN Al SUB x Ga SUB 1-x As **c76**
J. A. Kash, J. C. Tsang, and S. S. Jha (Tata Inst. of Fundamental Research, Bombay, India) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 76-78 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
Despite alloy disorder, picosecond Raman measurements show significant nonequilibrium phonon effects in Al(x)Ga(1-x)As. The virtual crystal approximation devices are considered. Author

N88-25789# Maryland Univ., College Park. Lab. for Physical Sciences.
INVESTIGATION OF PHOTOCONDUCTIVE PICOSECOND MICROSTRIPLINE SWITCHES ON SELF-IMPLANTED SILICON ON SAPPHIRE (SOS) **c76**
P. Polak-Dingels, G. Burdge, Chi H. Lee, A. C. Seabaugh, R. T. Brundage, M. I. Bell, and J. Albers (National Bureau of Standards, Gaithersburg, Md.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 79-81 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
Silicon-on-sapphire switches, damaged by Si implantation at fluence levels of 10 to the 13th to 10 to the 15th/sq cm, were characterized by picosecond cross-correlation, Raman, and resistivity measurements. Author

N88-25790# Technische Univ., Aachen (West Germany). Inst. of Semiconductor Electronics.
FAST GaAs PHOTOCONDUCTIVE DETECTORS WITH HIGH SENSITIVITY INTEGRATED IN COPLANAR SYSTEMS ONTO GaAs SUBSTRATES **c76**
H. Schumacher, U. Salz, and H. Beneking *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 82-85 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
An interdigitated photoconductive detector with fingers 1.5 micron wide was developed for optoelectronic correlation measurements. The very sensitive device fabricated onto s.i. GaAs and integrated in a coplanar line exhibits switching times of approximately 5 ps. Author

N88-25791# IBM Watson Research Center, Yorktown Heights, N.Y.
CARRIER LIFETIME VERSUS ION-IMPLANTATION DOSE IN SILICON ON SAPPHIRE **c76**
F. E. Doany, D. Grischkowsky, and C.-C. Chi *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 86-88 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
Measurements of the carrier lifetime of a systematic series of silicon-on-sapphire samples over a range of more than 4 orders of magnitude of O ion implantation are presented. Author

N88-25792# Maryland Univ., College Park. Dept. of Electrical Engineering.
PICOSECOND OPTOELECTRONIC SWITCHES USING COMPOSITE ELECTRONIC MATERIALS
E. A. Chauchard, Chi H. Lee, V. Diadiuk, and G. W. Turner (Massachusetts Inst. of Tech., Cambridge.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 89-91 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
Two composite picosecond optoelectronic switches were investigated. GaAs on silicon-on-sapphire exhibited a 20 ps response while InGaAs on InP shows a strong dependence of its response time on bias voltage. Author

N88-25793# Picosecond Pulse Labs., Inc., Boulder, Colo.
COMPARISON OF SAMPLING OSCILLOSCOPES WITH LESS THAN 35 ps TRANSITION DURATIONS **c35**
James R. Andrews *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 92-94 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
A 17 ps tunnel diode pulser was used to measure the transient responses of HP 1430, Tek S4, Tek S6, PSPL S-1430D, and Iwatsu SH-4B sampling oscilloscopes. Author

N88-25794# Rochester Univ., N. Y. Lab. for Laser Energetics.
A TECHNIQUE FOR WING SUPPRESSED IR SAMPLING
John Nees and Steve Williamson *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 95-96 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
An experiment demonstrating the feasibility of using optical frequency doubling as a tool for wing suppression in infrared sampling experiments is described. Author

N88-25795# Sandia National Labs., Albuquerque, N. Mex.
HIGH SPEED OPTO-ISOLATOR FOR RADAR APPLICATIONS **c32**
J. P. Anthes, P. Garcia, K. Y. Lau, and I. Ury (Ortel Corp., Alhambra, Calif.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 97-99 Previously announced as N87-18714 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
A high-speed unidirectional electronic coupler/switch that utilizes optoelectric components is demonstrated. High attenuation of counter propagating radar signals offers improved radar performance. DOE

N88-25796# Tektronix, Inc., Beaverton, Oreg.
ENERGY VARIATIONS IN OPTICAL PULSES FROM GAIN-SWITCHED AlGaAs DIODE LASERS **c36**
R. T. Hawkins, J. H. Goll, and N. A. Anheier *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 100-102 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
Optical pulses from gain-switched AlGaAs diode lasers, measured with a low noise CCD detector, are reported to have energy variation less than 1 percent rms for pulse durations of less than 60 ps. Author

N88-25797# Bell Telephone Labs., Inc., Holmdel, N. J.
CHARACTERISTICS, PACKAGING AND PHYSICS OF ULTRA HIGH SPEED DIODE LASERS AND DETECTORS **c36**
J. E. Bowers and C. A. Burrus *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 104-106 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
High-speed semiconductor lasers provide an efficient compact means of generating short tunable high power pulses. InGaAsP waveguide photodetectors have demonstrated high speed and high efficiency at zero bias. Author

N88-25798# Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Electrical Engineering.
FREQUENCY CHIRPING IN PULSE MODULATED GAIN AND REAL INDEX GUIDED SINGLE QUANTUM WELL LASERS **c36**
A. Larsson, P. Andersson, and A. Yariv (California Inst. of Tech., Pasadena.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 107-109 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
A small frequency chirp in pulse modulated real-index guided single quantum-well lasers and a strong influence of the guiding mechanism are examined. Author

N88-25799# Hewlett-Packard Co., Palo Alto, Calif.
InP/GaInAs/InP PIN PHOTODIODE WITH FWHM LESS THAN 18 ps **c76**
S. Y. Wang, K. W. Carey, and B. H. Kolner *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 110-112 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C
High-speed front-side illuminated InP/GaInAs/InP P-I-N 1 to 1.5 micro photodetectors were fabricated from material grown by atmospheric pressure organometallic vapor-phase epitaxy. The devices have external quantum efficiencies of greater than 85 percent at 1.3 micron and the temporal response has a full width half maximum of less than 18 ps. Dark current density is .0006 A/sq cm at the operating bias of -4 V. The interface is abrupt to two monolayers at the InP (substrate)-GaInAs heterojunction and five monolayers at the GaInAs/InP p-layer heterojunction. Author

N88-25800# Bell Telephone Labs., Inc., Holmdel, N. J.
PICOSECOND MEASUREMENTS OF GAIN-SWITCHING IN A SEMICONDUCTOR LASER DRIVEN BY ULTRASHORT ELECTRICAL PULSES **c36**
P. M. Downey, J. E. Bowers, R. S. Tucker, and J. M. Wiesenfeld

In Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 113-115 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

An InGaAsP laser, biased near threshold, is driven by 17 ps wide electrical pulses. Gain-switched pulses as short as 15 ps FWHM were observed. Author

N88-25801# IBM Watson Research Center, Yorktown Heights, N.Y.
MESFET COMPATIBLE IMSM DETECTORS **c32**
D. L. Rogers *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 116-120 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

A type of interdigitated metal-semiconductor-metal detector is described using a shallow implant to limit surface trapping, making it compatible with refractory gate MESFET processes. Author

N88-25802# Naval Research Lab., Washington, D.C.
PICOSECOND OPTICAL AUTOCORRELATION EXPERIMENTS ON FAST PHOTODETECTORS **c74**
T. F. Carruthers and J. F. Weller *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 121-123 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

The nonlinear component of the output of many picosecond photodetectors can be used to measure their intrinsic response times without resorting to cross-correlation circuits. Author

N88-25803# Bell Telephone Labs., Inc., Murray Hill, N. J.
DIRECT SUBPICOSECOND MEASUREMENT OF CARRIER MOBILITY OF PHOTOEXCITED ELECTRONS IN GaAs **c76**
M. C. Nuss and D. H. Auston *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 126-128 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

The carrier mobility of photoexcited hot electrons is measured directly for the first time on a subpicosecond time scale using femtosecond electrical pulses. Author

N88-25804# Illinois Univ., Urbana. Dept. of Electrical and Computer Engineering.
NON-STATIONARY TRANSPORT IN MODFET's AND HETEROJUNCTION DEVICES Abstract Only
K. Hess *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 129 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

New horizons have opened up in semiconductor research with the possibility of band gap engineering and the combination of single transport by photons as well as electrons in forms of ultrathin III-V compound layers. Self-consistence simulations of transient transport processes in single layer and single quantum-well modulation doped structures are reported. Simulations of picosecond and femtosecond thermalization after optical excitation are also reported and a comparison of the results with the experiments of Knox is given. Author

N88-25805# Arizona State Univ., Tempe. Center for Solid State Electronics Research.
MONTE CARLO INVESTIGATION OF HOT PHOTOEXCITED ELECTRON RELAXATION IN GaAs **c76**
M. A. Osman, M. J. Kann, D. K. Ferry, and P. Lugli (Modena Univ., Italy) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 130-132 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

The relaxation of hot photoexcited electrons is investigated in GaAs using an ensemble Monte Carlo approach, taking into account both the electron-hole interaction and the hot photon effect. Immediately after excitation by a 588 nm laser pulse, a considerable fraction of electrons transfers to the upper valleys instead of cascading down the central valley. Author

N88-25806# Texas Univ., Austin. Dept. of Physics.
LONGITUDINALLY LOCALIZED OPTICAL CARRIER INJECTION FOR FEMTOSECOND TRANSPORT STUDIES
M. C. Downer, D. H. Reitze, and T. R. Zhang *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 133-135 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

A technique for confining optical carrier excitation within a few hundred angstroms of a semiconductor surface opens possibilities for obtaining ballistic, quantum, and other femtosecond transport phenomena. Author

N88-25807# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science.
FEMTOSECOND NONEQUILIBRIUM ELECTRONIC HEAT TRANSPORT IN THIN GOLD FILMS **c76**
S. D. Brorson, J. G. Fujimoto, and E. P. Ippen *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 136-138 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Using a front pump/back probe technique, ultrafast heat transport through fold films was observed. The results suggest that transport occurs via nonequilibrium electrons. Author

N88-25808# IBM Watson Research Center, Yorktown Heights, N.Y.
BALLISTIC TRANSPORT AND HOT ELECTRON SPECTROSCOPY IN TUNNELING HOT ELECTRON TRANSFER AMPLIFIER (THETA) **c76**
M. Heiblum *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoeelectronics 1987 p 140-142 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

An unambiguous demonstration of ballistic (collisionless) electron transport was done in GaAs with the aid of a Tunneling Hot Electron Transfer Amplifier (THETA) device. Consequently, interesting quantum related phenomena were observed. Ballistic devices are potentially very fast; current gains as high as 10 were already measured at 77 K. Author

N88-25809# Massachusetts Inst. of Tech., Cambridge. Lincoln Lab.
MICROWAVE AND MILLIMETER-WAVE RESONANT TUNNELING DIODES
T. C. L. Gerhard Sollner, Elliott R. Brown, and W. D. Goodhue *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 143-145 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Several demonstrated resonant tunneling devices including oscillators, mixers, multipliers, and a variable negative resistance are discussed. Techniques of the millimeter/submillimeter regime are also described. Author

N88-25810# Texas Instruments, Inc., Dallas.
QUANTUM TRANSPORT CALCULATION OF RESONANT-TUNNELING RESPONSE TIME **c76**
William R. Frensley *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 146-148 Sponsored in part by ONR and Army Research Office (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

The transient response of a resonant tunneling diode is simulated by calculating the Wigner distribution. Switching times on the order of 100 fs are obtained. Author

N88-25811# Bell Telephone Labs., Inc., Murray Hill, N. J.
RESONANT TUNNELING ELECTRON SPECTROSCOPY **c76**
F. Capasso, S. Sen (Calcutta Univ., India), A. Y. Cho, and A. L. Hutchinson *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 149-151 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

An electron spectroscopy technique based on resonant tunneling was demonstrated. Direct information on the hot electron distribution function is obtained from the measured resonant tunneling collector current without requiring the use of derivative techniques. Author

N88-25812# Ecole Polytechnique, Palaiseau (France).
HIGH-SPEED PHENOMENA IN GaAs MULTIPLE-QUANTUM-WELLS **c76**
A. Mysyrowicz, D. Hulin, A. Migus, A. Antonetti, H. M. Gibbs, N. Peyghambarian, and H. Morkoc (Illinois Univ., Urbana.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 156-158 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Different optical phenomena occurring within a few picoseconds after irradiation of GaAs multiple-quantum-well structures with femtosecond laser pulses are discussed. Author

N88-25813# Bell Telephone Labs., Inc., Holmdel, N. J.
PICOSECOND CARRIER TRANSPORT IN GaAs QUANTUM WELLS **c76**
Jagdeep Shah and R. A. Hopfel *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 159-161 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Recent experiments in which picosecond optical pulses were used to investigate the physics of high field transport in GaAs quantum wells are discussed. Author

N88-25814# Bell Telephone Labs., Inc., Holmdel, N. J.
QUANTUM-CONFINED STARK EFFECT IN InGaAs/InP QUANTUM WELLS GROWN BY METAL-ORGANIC CHEMICAL VAPOR DEPOSITION **c76**
I. Bar-Joseph, C. Klingshirn (Joensuu Univ., Finland), D. A. B. Miller, D. S. Chemla, U. Koren, and B. I. Miller *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 162-165 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Large shifts of absorption spectrum in InGaAs/InP multiple quantum wells with applied electric fields are reported. Applications for light modulators are discussed. Author

N88-25815# Bell Telephone Labs., Inc., Holmdel, N. J.
DYNAMICS OF BELOW-GAP PHOTOEXCITATION IN GaAs QUANTUM WELLS **c76**
J. E. Zucker, A. VonLehmen, D. S. Chemla, and J. P. Heritage (Bell Communications Research, Inc., Red Bank, N.J.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 166-168 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Time-resolved transmission experiments in GaAs quantum wells show that photoexcitation in the transparent region of the heterostructure can produce a striking variety of excitonic effects. Author

N88-25816# Texas A&M Univ., College Station. Dept. of Electrical Engineering.
RADAR AND EW APPLICATIONS OF MULTI-GIGAHERTZ OPTICAL COMPONENTS AND SYSTEMS **c32**
Henry F. Taylor *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 170-172 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Optical techniques for the generation, control, transmission, and processing of wideband signals in military systems are discussed. Author

N88-25817# Hughes Research Labs., Malibu, Calif.
CHARACTERISTICS AND APPLICATION OF WIDEBAND GUIDED-WAVE DEVICES **c32**
C. M. Gee, G. D. Thurmond, and H. W. Yen *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 173-175 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Design and fabrication of wideband and high-speed guided-wave electro-optic and electroabsorption devices are reviewed. Their application in RF fiber-optic links are presented. Author

N88-25818# Maryland Univ., College Park. Dept. of Electrical Engineering.
A NEW OPTOELECTRONIC CW MICROWAVE SOURCE
C. J. Clark, E. A. Chauchard, K. Webb, K. Zaki, C. H. Lee, P. Polak-Dingles, H.-L. A. Hung, and Ho C. Huang (Communications Satellite Corp., Clarksburg, Md.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 176-178 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

A CW microwave source which can be time-synchronized with laser pulses is described. Its phase noise of 3.5 ps is attributed primarily to the laser time jitter. Author

N88-25819# Bell Telephone Labs., Inc., Holmdel, N. J.
OPTICAL MODULATION ABOVE 20 GHz USING A WAVEGUIDE ELECTROOPTIC SWITCH **c74**
S. K. Korotky, G. Eisenstein, R. S. Tucker, J. J. Veselka, and G. Raybon *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 179-181 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

The intensity modulation of an optical carrier at frequencies above 20 GHz using a Ti:LiNbO3, optical waveguide switch is examined. A self electro-optic sampling technique is used to observe the modulation. Author

N88-25820# Texas Univ., Austin. Dept. of Electrical and Computer Engineering.
PICOSECOND RESPONSE OF AN OPTICALLY CONTROLLED MILLIMETER WAVE PHASE SHIFTER
C.-K. C. Tzuang, D. Miller, T.-H. Wang, T. Itoh, D. P. Neikirk, P. Williams, and M. Downer *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 182-184 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

The dispersion of a picosecond pulse propagating along a coplanar waveguide on a semiconductor substrate is studied. Numerical calculations are used to predict the pulse shape for varying carrier concentrations in a multilayer AlGaAs/GaAs/AlGaAs structure. Author

N88-25821# Rochester Univ., N. Y. Lab. for Laser Energetics.
ELECTRON DEVICE PROBING IN THE FEMTOSECOND TIME SCALE
Gerard A. Mourou *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and

Optoelectronics 1987 p 186-187 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Femtosecond optical techniques were used to time resolve electrical waveforms with femtosecond resolution or terrahertz bandwidth. The techniques were used to study the response of ultrafast components such as MESFET, MODFET, permeable base device Josephson junction, and normal or superconducting transmission lines and more recently transient transport in semiconductors such as velocity overshoot and resonant tunneling. Present and future roles of optical techniques in electronics form a device characterization and physics point. Author

N88-25822# Bell Telephone Labs., Inc., Murray Hill, N. J.
ELECTRICAL PULSE COMPRESSION BY TRAVELING-WAVE PHOTOCONDUCTIVITY
D. H. Auston, M. C. Nuss, and P. R. Smith *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 188-190 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

A technique is described for compressing picosecond electrical pulses by reflecting them from a moving mirror produced by a traveling wave photoconductor having a velocity close to the electrical propagation velocity. Author

N88-25823# IBM Watson Research Center, Yorktown Heights, N.Y.
PICOSECOND OPTOELECTRONIC STUDY OF A THIN FILM TRANSMISSION LINE STRUCTURE
G. Arjavalingam, J.-M. Halbout, G. V. Kopcsay, and M. B. Ketchen *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 191-193 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Using photoconductive generated picosecond electrical pulses the properties of a transmission line structure consisting of coupled microstrip lines separated from a ground plane by a thin insulator are studied. In addition to the distortion of the transmitted pulses, the rear- and far-end coupled noise are characterized with picosecond resolution. Author

N88-25824# Lawrence Livermore National Lab., Calif.
SILICON PULSE SHARPENING DIODES-SWITCHING KILOVOLTS IN 10'S OF PICOSECONDS
M. D. Pocha, J. D. Wiedwald, C. G. Dease, and M. M. Contreras (New Mexico Univ., Albuquerque.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 194-196 Previously announced as N87-22905 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

Numerical analysis was used to determine the physical mechanisms involved in silicon switching diodes. Plots of values for free carrier densities, current density, and electric fields, were used in visualizing the operation of these devices. It is concluded that the large initial electric field present in the diode is responsible for its behavior. DOE

N88-25825# Naval Ocean Systems Center, San Diego, Calif.
ON 3-5 TRANSISTORS FOR MM-WAVE APPLICATIONS Professional Paper, period ending Oct. 1987
J. R. Zeidler and J. D. Murphy Dec. 1987 6 p
(AD-A191580) Avail: NTIS HC A02/MF A01 CSCL 09A

The ability of operate at frequencies at and above 60 GHz is desirable in many applications to increase bandwidth, achieve more favorable tradeoffs between antenna beamwidth and size, and to exploit frequency dependent transmission properties of the atmosphere. Corresponding device and circuit requirements are delineated. One especially demanding requirement is to develop phased arrays at 60 and 94 GHz. At 94 GHz this requires an array of transmit/receive (T/R) modules with center to center spacings of 1.5 mm between modules. Generating the required output power without exceeding thermal dissipation limits places stringent requirements on the solid state components of the T/R module. The first 60 GHz transistor amplifier was developed in 1983 using GaAs MESFETs. The DARPA Strategic Technology Office quickly initiated a program to extend these capabilities to develop a 60 GHz T/R module for satellite-to-satellite communications applications. Concurrently, in expectation that MESFET performance might prove inadequate for some EHF applications, the DARPA Defense Sciences Office initiated a program to develop alternative EHF transistor technologies. Various planar and vertical device structures have been fabricated and devices with measured gain at 94 GHz and projected values of the maximum frequency of oscillation, fmax up to 220 GHz have been developed under this program and others. GRA

N88-25826# Mound Lab., Miamisburg, Ohio.
FABRICATION OF A FLEXIBLE CONDUCTOR BY VAPOR DEPOSITION
J. A. Bailey and G. V. Nesslage 15 Mar. 1988 20 p
(Contract DE-AC04-76DP-00053)
(DE88-007500; MLM-3481) Avail: NTIS HC A03/MF A01

A physical vapor deposition (PVD) process was developed to deposit copper coatings on polyimide films (Kapton). The Kapton is prepared in a 35-mm format and is metallized to provide flexible conductor material for flat cable fabrication. A prototype PVD process capable of yielding 95 ft of metallized Kapton tape with a copper thickness variation of +-5% was developed. Metallized tape was prepared in thicknesses ranging from 0.5 to 4.0 cm. DOE

N88-25827# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
TEST RESULTS OF THE ELECTRIC VEHICLE FIELD-LABORATORY CORRESPONDENCE PROGRAM, PHASE 1 REPORT
R. D. MacDowall Dec. 1987 43 p
(Contract DE-AC07-76ID-01570)
(DE88-007706; EGG-EP-7944) Avail: NTIS HC A03/MF A01

During the past decade a signficant number of vehicles, batteries, and powertrain components have been evaluated by the US Department of Energy (DOE) Electric and Hybrid Vehicle Program. These evaluation tests have been performed in dynamometer laboratories, on test tracks, and on the road under actual field operating conditions. Previous DOE-funded programs have developed several computer models which simulate electric vehicle performance over a wide range of operating conditions. This report presents the results of tests performed by EG and G Idaho, Inc., at the Idaho National Engineering Laboratory (INEL). The primary objective of the Electric Vehicle Field-Laboratory Correspondence Program is to significantly enhance the ability to predict field performance from laboratory test results, and to predict the behavior of vehicle systems not yet fabricated. A secondary objective of this program is to obtain real-time based data with the INEL Portable Data Acquisition system (PDAS) which can then be compared to the event-based test data acquired using the Versatile Data Acquisition System (VDAS). The VDAS-to-PDAS comparisons from these tests indicate the relative strengths and limitations of these rather different approaches to in-vehicle acquisition of engineering data. The conclusions of this first phase report indicate that the corresondence among the data acquisition systems was comparable to test-to-test repeatability, and that the energy consumption values matched closely among dynamometer, track, and tightly controlled road tests. DOE

N88-25828# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
STATISTICAL EVALUATION OF LIGHT WATER REACTOR PIPING DAMPING DATA FOR USE IN PRA (PROBABILISTIC RISK ASSESSMENT) ANALYSES
A. G. Ware 1988 10 p Presented at the ASME Pressure Vessel and Piping Conference, Pittsburgh, Pa., 19 Jun. 1988
(Contract DE-AC07-76ID-01570)
(DE88-007708; EGG-M-29987; CONF-880661-5) Avail: NTIS HC A02/MF A01

This paper presents the results of studies used to quantify, on a statistical basis, one of the parameters (piping system damping) input to probabilistic risk assessment (PRA) analyses of nuclear structures. Damping data were selected from tests in which the piping had been vibrated at levels representative of at least moderate severity seismic or hydrodynamic transients. These data, representing 27 light water reactor type piping systems, formed the basis for the statistical damping study. Most of these systems were actual nuclear power plant systems, and the lowest mode was < 8 Hz in over 80/percent/ of the systems. Damping was treated as independent of frequency (or mode number). The statistical analysis showed that a lognormal probability fit provided a suitable approximation of the raw data. For the cases in which all data were considered (which allowed duplicate tests for each system to be included so that the overall data were biased by those systems with the most data), mean lognormal damping values ranged from 2.68/percent/ to 3.55/percent/ of critical. When duplicate tests were eliminated, the means ranged from 3.12/percent/ to 3.72/percent/ of critical. For the final cases, which considered only the lowest mode at its highest excitation level, mean lognormal damping values ranged from 3.28/percent/ to 6.50/percent/ of critical. DOE

N88-25829 Stanford Univ., Calif.
HOT CARRIER EFFECTS IN CMOS FIELD EFFECT TRANSISTORS AT CRYOGENIC TEMPERATURES Ph.D. Thesis
Albert Karl Henning 1987 214 p
Avail: Univ. Microfilms Order No. DA8800950

Silicon is the material of choice for fabrication of high circuit density, low defect density and high speed integrated devices. CMOS technology provides the additional advantage of low power dissipation. These features make CMOS technology an attractive candidate to take advantage of the performance enhancements available through liquid nitrogen temperature operation. However, low temperature operation may increase the hot carrier generation of both substrate and gate currents, which can degrade device performance and reliability. An overview is presented of the advantages and drawbacks of cryogenic device operation. Hot carrier effects are emphasized, since they prove detrimental to operation at both normal and cryogenic temperatures. The voltage dependences, temperature, and channel length of the weak avalanche substrate current between 77 and 300 K characterization is presented. A microscopic, physical model based on Shockley's lucky electron approach is described which explains this impact ionization behavior. The model incorporates a Maxwell-Boltzmann distribution of hot carrier energies beyond the band minima, and is implemented in the 2-D device simulators. Dissert. Abstr.

N88-25830*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A ROLE FOR HIGH FREQUENCY SUPERCONDUCTING DEVICES IN FREE SPACE POWER TRANSMISSION SYSTEMS
Jose L. Christian, Jr. and Ronald C. Cull 1988 11 p Presented at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. - 5 Aug. 1988; sponsored by ASME, AIAA, ANS, SAE, IEEE, ACS and AIChE
(NASA-TM-100971; E-4264; NAS 1.15:100971) Avail: NTIS HC A03/MF A01 CSCL 10B

Major advances in space power technology are being made in photovoltaic, solar thermal, and nuclear systems. Despite these advances, the power systems required by the energy and power intensive mission of the future will be massive due to the large collecting surfaces, large thermal management systems, and heavy shielding. Reducing this mass on board the space vehicle can result in significant benefits because of the high cost of transporting and moving mass about in space. An approach to this problem is beaming the power from a point where the massiveness of the power plant is not such a major concern. The viability of such an approach was already investigated. Efficient microwave power beam transmission at 2.45 GHz was demonstrated over short range. Higher frequencies are desired for efficient transmission over several hundred or thousand kilometers in space. Superconducting DC-RF conversion as well as RF-DC conversion offers exciting possibilities. Multivoltage power conditioning for multicavity high power RF tubes could be eliminated since only low voltages are required for Josephson junctions. Small, high efficiency receivers may be possible using the reverse Josephson effects. A conceptual receiving antenna design using superconducting devices to determine possible system operating efficiency is assessed. If realized, these preliminary assessments indicate a role for superconducting devices in millimeter and submillimeter free space power transmission systems. Author

N88-25831*# Sverdrup Technology, Inc., Cleveland, Ohio.
AGING BEHAVIOR OF Au-BASED OHMIC CONTACTS TO GaAs Final Contractor Report
Navid S. Fatemi Jul. 1988 15 p
(Contract NAS3-24105)
(NASA-CR-182146; E-4171; NAS 1.26:182146) Avail: NTIS HC A03/MF A01 CSCL 09A

Gold based alloys, commonly used as ohmic contacts for solar cells, are known to react readily with GaAs. It is shown that the contact interaction with the underlying GaAs can continue even at room temperature upon aging, altering both the electrical characteristics of the contacts and the nearby pn junction. Au-Ge-Ni as-deposited (no heat treatment) contacts made to thin emitter (0.15 micrometer) GaAs diodes have shown severe shunting of the pn junction upon aging for several months at room temperature. The heat-treated contacts, despite showing degradation in contact resistance did not affect the underlying pn junction. Au-Zn-Au contacts to p-GaAs emitter (0.2 micrometer) diodes, however, showed slight improvement in contact resistance upon 200 C isothermal annealing for several months, without degrading the pn junction. The effect of aging on electrical characteristics of the as-deposited and heat-treated contacts and the nearby pn junction, as well as on the surface morphology of the contacts are presented. Author

N88-25832# Mission Research Corp., Albuquerque, N. Mex.
PHOTOCURRENT MODELING OF MODERN MICROCIRCUIT PN JUNCTIONS
E. W. Enlow and D. R. Alexander 1988 5 p Presented at the 25th Annual Conference on Nuclear and Space Radiation Effects, Portland, Ore., 12 Jul. 1988
(Contract DE-AC04-76DP-00789)
(DE88-007037; SAND-88-7020C; CONF-880730-5) Avail: NTIS HC A02/MF A01

Mathematical models are described for time dependent photocurrents in a PN junction. The models incorporate high injection effects on lifetime, electric fields in the bulk quasi-neutral region, and diode length effects. A subroutine suitable for use in SPICE 2 implements the models. DOE

N88-25833# Los Alamos National Lab., N. Mex.
THERMIONIC INTEGRATED CIRCUIT PROGRAM Final Report
D. K. Wilde, D. K. Lynn, and D. Hamilton May 1988 162 p
(Contract W-7405-eng-48)
(DE88-010119; LA-11284-MS) Avail: NTIS HC A08/MF A01

This report describes the development of an operational amplifier using radiation hardened Thermionic Integrated Circuits (TICs). The report is written as a tutorial to cover all aspects of the fabrication process and circuit development as well as the process and circuit modifications required to meet the integration requirements of the operational amplifier. Recent experimental results are discussed in which both devices and test circuit data are compared to theoretical computer code predictions. The development of compatible high-temperature thin-film resistors is also presented. Because the project is being terminated prior to the completion of the amplifier, suggestions are made for additional advance development. DOE

N88-25834# California Univ., Berkeley. Lawrence Berkeley Lab.
ALL INORGANIC AMBIENT TEMPERATURE RECHARGEABLE LITHIUM BATTERY Final Report

H. C. Kuo, A. N. Dey, C. Schlaikjer, D. Foster, and M. Kallianidis Oct. 1987 225 p
(Contract DE-AC03-76SF-00098)
(DE88-008425; LBL-24295) Avail: NTIS HC A10/MF A01

Having the advantages of high energy density and good charge retention, rechargeable lithium batteries have been of interest to many companies and research organizations within the last 15 years. Various lithium rechargeable systems with different positive electrodes and electrolytes have been reported in literature. Most are using electrolytes with organic solvents. Duracell Inc. has demonstrated the feasibility of using totally inorganic electrolytes based on liquid SO2 for the ambient temperature recharageable lithium battery. The system has lithium as the negative electrode and porous carbon as the positive electrode with SO2 as the depolarizer and electrolyte solvent. A four year cost-shared joint program with the Department of Energy was initiated in October 1980 to investigate the SO2-based electrolytes and to develop an ambient temperature rechargeable lithium battery for future energy storage applications. The ultimate goal of this program is to develop a battery having an energy density over 150 whkg with cycle life of 500 to 800 at 80 to 100 percent depth of discharge. During the four years, SO2 electrolytes with various inorganic salts and various positive electrodes made of porous carbon and solid active materials were evaluated. Promising systems having good rechargeability and high energy density, such as LiCuCl2 and LiLiAlCl4-SO2 carbon were identified. This report summarizes the progress achieved in the program. DOE

N88-25883# Katholieke Universiteit te Leuven (Belgium). Dept. Electrotechniek.
SILVER MULTI-LAYERS FOR PLANAR Ag/AgCl REFERENCE ELECTRODES
M. Lambrechts, J. Suls, and W. Sansen *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p Sponsored in part by IWONL and IMEC, Belgium (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

N88-25884# National Bureau of Standards, Gaithersburg, Md.
THE STRUCTURE AND PROPERTIES OF RF REACTIVE SPUTTERED IrO2 FILMS
Kenneth G. Kreider *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N88-25835# Naval Ocean Systems Center, San Diego, Calif.
ACTIVE CONTROL OF 2-D INSTABILITY WAVES ON AN AXISYMMETRIC BODY Professional Paper, period ending Aug. 1987
D. M. Ladd and E. W. Hendricks Dec. 1987 4 p
(AD-A191578) Avail: NTIS HC A02/MF A01 CSCL 14B

Experimental studies have demonstrated the feasibility of Tollmien-Schlichting (T-S) disturbance cancellation in flat plate boundary layers using a variety of active sources. What is detailed herein is the first experimental study of the generation and cancellation of laminar-instability (T-S) waves by adaptive heat addition to a laminar boundary layer of an axisymmetric body. Tests were performed in a water tunnel environment on a 9:1 fineness ratio ellipsoid utilizing strip heaters to create and actively attenuate laminar instability waves. The attenuation signal was synthesized by a modified adaptive filter. The filter was able to actively adapt the attenuation signal to changes in amplitude and frequency of the instability wave with no loss in attenuation downstream. Two important distinctives between Liepmann's work and the current study are the method of signal processing used and the introduction of three dimensionality in the flow. In our work the application of digital filtering techniques to the synthesis of the cancellation signal is unique. Further the flow geometry, although not a fully three dimensional, has elements of three dimensionality that further complicate the utilization of selective heat addition. The current experimental program has established that active heat addition controlled by a digital adaptive filter can successfully attenuate T-S waves in an axisymmetric geometry. GRA

N88-25836# Johns Hopkins Univ., Baltimore, Md. Dept. of Rational Mechanics.
APPLICATIONS OF SOME NEW IDEAS ON IRREVERSIBLE PROCESSES TO PARTICULAR FLUIDS Final Report
Clifford A. Truesdell 23 Sep. 1987 2 p
(AF Proj. 2304)
(AD-A191610; AFOSR-87-2035TR) Avail: NTIS HC A02/MF A01 CSCL 20D

The proposal for the grant set forth a program of research for three years, the first of which was to survey available literature, methods, and results concerning flow of fluids of grade 2. This activity was completed for the first year. GRA

N88-25837# United Technologies Research Center, East Hartford, Conn.
STUDY OF THE STRUCTURE OF TURBULENCE IN ACCELERATING TRANSITIONAL BOUNDARY LAYERS Final Technical Report, 5 Oct. 1984 - 22 Sep. 1987
Michael F. Blair and Olof L. Anderson 23 Dec. 1987 219 p
(Contract F49620-84-C-0050)
(AD-A191698; UTRC/R87-956900-1; AFOSR-88-0017TR) Avail: NTIS HC A10/MF A01 CSCL 20D

A combined experimental and analytical program has been conducted to examine transitional, accelerating boundary layer flows with high levels of freestream turbulence. An earlier program focused on measurement of transitional heat transfer distributions for four combinations of streamwise acceleration and freestream turbulence. The present program was designed to document the boundary layer turbulence structure and spectral distributions for the same four test conditions. The results from the present program have shown that transition in accelerating flows consists of an acceleration dominated stage of slowly developing intermittency followed by a second stage with the same general characteristics as zero-pressure-gradient transition. Conditionally sampled fluctuating velocity profile measurements indicated that the boundary layer turbulence was highly anisotropic in the early stages of transition. Conditionally sampled mean velocity measurements showed that within the intermittent turbulent patches the mean velocity profiles were very similar to those of an equilibrium turbulent boundary layer. Spectral distribution data indicated that preferred amplification of the most unstable (as predicted by linear stability theory) frequencies occurred upstream of the onset of transitional bursting. GRA

N88-25838# Naval Ocean Systems Center, San Diego, Calif.
COMPARISON OF THE WALL PRESSURE FLUCTUATIONS IN ARTIFICIALLY GENERATED TURBULENT SPOTS, NATURAL TRANSITION AND TURBULENT BOUNDARY LAYERS
Thomas S. Mautner Jan. 1988 9 p
(AD-A191777) Avail: NTIS HC A02/MF A01 CSCL 20D

Experiments have been conducted to measure the wall pressure fluctuations associated with artificially generated turbulent spots in a laminar boundary layer. The results show that both the rms wall pressure and the wall pressure spectra of turbulent spots are influenced by the local mean flow pressure gradient. The zero and favorable pressure gradient wall pressure data are in agreement with turbulent boundary layer results. However, the current spot data shows that, in the presence of an adverse pressure gradient, the spot's rms wall pressure is approximately 1.5-2.5 times larger than that found for the zero and favorable

pressure gradient cases. These results are in general agreement with the adverse pressure gradient data of Huang and Hannan (1975). Additionally, the nearly constant magnitude of the spot's adverse pressure gradient wall pressure spectrum indicates a nearly even distributions of energy with frequency. GRA

N88-25839# Minnesota Univ., Minneapolis. Hydraulic Lab.
NOISE GENERATION BY AIR BUBBLES IN WATER: AN EXPERIMENTAL STUDY OF CREATION AND SPLITTING
Kenneth W. Frizell and Roger E. Arndt Dec. 1987 60 p
(Contract N00167-86-K-0054)
(AD-A192063; Rept-269) Avail: NTIS HC A04/MF A01 CSCL 07B

Although the study of two-phase flow, especially air-water mixtures, has received much attention in recent years, little has been done concerning the noise generated by non-cavitating air water flows. The main purpose of this work is to examine these flows; in particular, to look at the noise associated with the creation of air bubbles at a nozzle, and the noise radiated by air bubbles splitting in the shear layer of a submerged turbulent water jet. Experiments were conducted to measure the sound pressure levels associated with bubble creation and bubble splitting, under a variety of conditions. Comparisons were made with existing theories. An improved physical understanding of the mechanism of noise generation was gained through data analysis and photographic studies. Recommendations for further research are given. GRA

N88-25840# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
FLUID DYNAMICS OF HIGH PERFORMANCE TURBOMACHINES Annual Report, 19 Oct. 1986 - 18 Oct. 1987
Edward M. Greitzer, Alan H. Epstein, Michael B. Giles, James E. McCune, and Choon S. Tan Dec. 1987 131 p
(Contract F49620-85-C-0018)
(AD-A192073; AFOSR-88-0183TR) Avail: NTIS HC A07/MF A01 CSCL 20D

Within the general topic, four separate tasks are specified, i.e.: 1) Loss mechanisms and loss migration in transonic compressors, including development of advanced instrumentation for measurements of wake radial transport and analysis of unsteady vortical wake structures; 2) Experimental and theoretical study of flows in casing and hub treatment, including mechanisms for stability enhancement in compressors and unsteady fluid dynamic interactions between passage and groove flows; 3) Computational techniques for turbomachinery, including inverse (design) calculation procedures for transonic turbomachine blades accounting for viscid/inviscid interaction; and 4) Theoretical modelling of stability and unsteadiness in transonic compressor flow fields, including analyses of unsteady fluctuations due to vortex shedding. GRA

N88-25841*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BOUNDARY LAYER DEVELOPMENT AS A FUNCTION OF CHAMBER PRESSURE IN THE NASA LEWIS 1030:1 AREA RATIO ROCKET NOZZLE
Tamara A. Smith 1988 33 p Presented at the 24th Joint Propulsion Conference, Boston, Mass., 11-13 Jul. 1988; sponsored by AIAA, ASEE, ASME and SAE
(NASA-TM-100917; E-4078; NAS 1.15:100917) Avail: NTIS HC A03/MF A01 CSCL 20D

Through the use of theoretical predictions of fluid properties and experimental heat transfer and thrust measurements, the zones of laminar, transitional, and turbulent boundary layer flow were defined for the NASA Lewis 1030:1 area ratio rocket nozzle. Tests were performed on the nozzle at chamber pressures from 350 to 100 psia. For these conditions, the throat diameter Reynolds numbers varied from 300,000 to 1 million. The propellants used were gaseous hydrogen and gaseous oxygen. Thrust measurements and nozzle outer wall temperature measurements were taken during the 3-sec test runs. Comparison of experimental heat transfer and thrust data with the corresponding predictions from the Two-Dimensional Kinetics (TDK) nozzle analysis program indicated laminar flow in the nozzle at a throat diameter Reynolds number of 320,000 or chamber pressure of 360 psia. Comparison of experimental and predicted heat transfer data indicated transitional flow up to and including a chamber pressure of 1000 psia. Predicted values of the axisymmetric acceleration parameter within the convergent and divergent nozzle were consistent with the above results. Based upon an extrapolation of the heat transfer data and predicted distributions of the axisymmetric acceleration parameter, transitional flow was predicted up to a throat diameter Reynolds number of 220,000 or 2600-psia chamber pressure. Above 2600-psia chamber pressure, fully developed turbulent flow was predicted. Author

N88-25842 Centre d'Etudes et de Recherches, Toulouse (France).
ANALYSIS AND MODELING OF COMPLEX NON-STATIONARY FLOWS Final Report
M. Bourgeois, G. Lavergne, C. Lempereur, and J. M. Mathe Feb. 1987 93 p In FRENCH Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France
(PB88-127188) Avail: NTIS HC E05/MF E05 CSCL 20D

The shearing instabilities generated by concurrent two-dimensional vertical flows were studied experimentally on displays and with image processing. A numeric simulation of this type of flow based on the theory of singularities was developed. In order to characterize three-dimensional instabilities, a feasibility study of the restitution of three-dimensional trajectories in the wake of a sphere is proposed. Author

N88-25843 Rensselaer Polytechnic Inst., Troy, N.Y.
THE PROPAGATION OF PRESSURE PERTURBATIONS IN BUBBLY AIR/WATER FLOWS Ph.D. Thesis
Arthur Elwood Ruggles 1987 265 p
Avail: Univ. Microfilms Order No. DA8729322

The propagation of acoustic pressure perturbations in an adiabatic low quality air/water flow were investigated both theoretically and experimentally. A linearized dispersion model is correlated with data to extract information on the behavior of interfacial momentum transfer controlled by the virtual volume coefficient. The dispersion model is examined in limiting cases of low and high frequency and related to current models for critical flow velocity. Fourier decomposition techniques are employed to predict the dispersion of measured pressure pulses and to relate data for standing waves and propagating pulses. The dispersion model is based on a two-fluid model and is the most complete model available in the literature at this time. The dispersion data presented are also the best available to date for low frequency sound propagation in bubbly air/water mixtures. Dissert. Abstr.

N88-25844# Lawrence Livermore National Lab., Calif.
LLNL GRANULAR SOLIDS FLOW PROJECT Quarterly Report, Oct. - Dec. 1987
O. R. Walton, ed. Jan. 1988 10 p
(Contract W-7405-eng-48)
(DE88-008023; UCID-20297-87-4) Avail: NTIS HC A02/MF A01

This project is directed toward obtaining a fundamental understanding of the flow behavior of granular solids and multi-phase solids-containing systems. Here we report progress in two new areas of study, quasi-static deformations and suspension rheology. Discrete particle computer models have the potential for becoming very useful tools for understanding such problems. We have begun a reexamination of our computer models to see how they can most effectively be applied to the many granular solids flow problems that involve quasi-static deformations. We have carefully reviewed our models of tagential friction between elastic spheres in contact, and have developed improved algorithms. We have also initiated development of more complex models that include adhesive surface forces and non-constant coefficients of friction. These new algorithms will be added to the 3DSHEAR model in the near future. We are examining various approaches to determine the rheologic properties of suspensions. As part of this effort we are developing a general numerical method

to calculate the hydrodynamic interactions for arbitrary assemblies of spheres in suspension. The first results with this method involve assemblies of a small number of equal size spheres with periodic boundaries. DOE

N88-25845# International Centre for Theoretical Physics, Trieste (Italy).
NON EQUILIBRIUM EXPANSION OF A RADIATING GAS IN A CHANNEL OF VARYING SECTION
A. R. Bestman Jul. 1987 22 p
(DE88-702063; IC-87/177) Avail: NTIS (US Sales Only) HC A03/MF A01

The problem considers non equilibrium supersonic expansion of a vibrationally relaxing and thermally radiating gas in a channel whose section varies slowly in the axial direction. To avoid excessively large pressures, the density is taken to be low. Assuming an optically thin radiating gas and the differential Navier Stokes equations of continuum together with the slip boundary conditions for a slightly rarefied gas, the problem is reduced to a set of coupled nonlinear partial differential equations. Asymptotic approximation is employed to tackle an otherwise intractible problem. The problem affords an idealized model for gasdynamic lasers where in reality the supersonic expansion is in a nozzle. DOE

N88-25846# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki.
DISSIPATIVE RELATIVISTIC RADIATION HYDRODYNAMICS
V. S. Imshennik and Yu. I. Morozov 1987 32 p In RUSSIAN
(DE88-702092; ITEF-17(1987)) Avail: NTIS (US Sales Only) HC A03/MF A01

Equations of relativistic radiation hydrodynamics with provision for dissipative effects in matter as well as with provision for interaction of almost equilibrium (Planck) radiation and matter have been derived using an accompanying reading system in a general noninertial case. Explicit expressions for additional dissipative coefficients corresponding to this interaction: radiation thermal conductivity, shift and volumetric radiation viscosities have been obtained. Arbitrary processes of photon absorption in matter as well as processes of Compton photon scattering by electrons have been taken into account as interaction processes. The general result of the given work is a closed set of equations of dissipative relativistic radiation hydrodynamics in the accompanying reading system - relativistic generalization of known equations of radiation hydrodynamics for Lagrangian coordinates. Equations are derived for spherically symmetrical problem with provision for gravitation. DOE

N88-25847*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SCALING LAWS FOR HOMOGENEOUS TURBULENT SHEAR FLOWS IN A ROTATING FRAME Final Report
Charles G. Speziale and Nessan MacGiolla Mhuiris Jun. 1988 26 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181672; ICASE-88-34; NAS 1.26:181672) Avail: NTIS HC A03/MF A01 CSCL 20D

The scaling properties of plane homogeneous turbulent shear flows in a rotating frame are examined mathematically by a direct analysis of the Navier-Stokes equations. It is proved that two such shear flows are dynamically similar if and only if their initial dimensionless energy spectrum E star (k star, 0), initial dimensionless shear rate SK sub 0/epsilon sub 0, initial Reynolds number K squared sub 0/nu epsiion sub 0, and the ration of the rotation rate to the shear rate omega/S are identical. Consequently, if universal equilibrium states exist, at high Reynolds numbers, they will only depend on the single parameter omega/S. The commonly assumed dependence of such equilibrium states on omega/S through the Richardson number Ri=-2(omega/S)(1-2 omega/S) is proven to be inconsistent with the full Navier-Stokes equations and to constitute no more than a weak approximation. To be more specific, Richardson number similarity is shown to only rigorously apply to certain low-order truncations of the Navier-Stokes equations (i.e., to certain second-order closure models) wherein closure is achieved at the second-moment level by assuming that the higher-order moments are a small perturbation of their isotropic states. The physical dependence of rotating turbulent shear flows on omega/S is discussed in detail along with the implications for turbulence modeling. Author

N88-25848 Stanford Univ., Calif.
EXPERIMENTAL AND ANALYTICAL STUDIES OF COMPRESSIBLE VORTICES Ph.D. Thesis
Michael Joseph Mandella 1987 261 p
Avail: Univ. Microfilms Order No. DA8800984

The structure of a compressible free vortex was analyzed while undergoing convection in a quasi-uniform stream flow. Holographic interferograms reveal radial density profiles of the vortex at different stages of its development during convection. A general mathematical expression is found which closely describes the distribution of density inside the vortex. By use of experimental data and the governing equations in an empirical/theoretical analysis, an extended physical description of the vortex is developed. The time behavior of the density, determined from the experiments, allows the solution of the Continuity Equation and a distribution of the radial component of fluid velocity relative to the vortex center is obtained. The density information, supplemented by an independent determination of pressure is then used in the Radial Momentum Equation to obtain a distribution of the circumferential component of fluid velocity relative to the vortex center, thus completing the description of the radial dependence of the velocities inside the vortex. Dissert. Abstr.

N88-25849 Oregon Univ., Eugene.
SUPERFLUID TURBULENCE IN COUNTERFLOWING HELIUM II Ph.D. Thesis
Rabi Tsai-Hung Wang 1987 104 p
Avail: Univ. Microfilms Order No. DA8800559

Superfluid turbulence in counterflowing He II has long been considered to be a tangle of quantized vortex lines. An exploration of the tangle is presented. A simultaneous survey of temperature gradients, axial second sound attenuation, and transverse second sound attenuation produced by counterflow with helium bath temperatures from 1.27 to 2.10 K, is reported. From these measurements and the use of vortex dynamics the total line density, anisotropy, and average induced drift of the vortex tangle is calculated. A much higher probability is found for vortex lines in the tangle to be transverse to the flow than along the flow. It was also found that, at least below 2.1 K, the vortex tangle drifts with the superfluid toward the heater. For a further investigation, the velocity of second sound in He II under its saturated vapor pressure was measured in an acoustic resonator with a typical precision of 0.07 percent and was found to agree with existing measurements within their stated uncertainties. Dissert. Abstr.

N88-25850 Stanford Univ., Calif.
NUMERICAL SIMULATION STUDIES OF LAMINAR-TURBULENT TRANSITION IN THE PLAN CHANNEL Ph.D. Thesis
Bart Alan Singer 1987 154 p
Avail: Univ. Microfilms Order No. DA8801031

Laminar-turbulent transition in the plane channel was studied via direct numerical simulation of the Navier-Stokes equations. The study allows both the subharmonic and fundamental modes to grow from an initial state of random noise. Wind tunnel experiments in the plane channel do not show evidence of the Herbert modes unless they are forced with a subharmonic disturbance. It is hypothesized that this is due to the presence of streamwise vortices in the wind tunnel, which are included in the simulations. To help in the analysis of transitional flows, how the intermodal energy transfer rates varied across the channel were studied. The primary 2D wave gives energy to the 3D waves in the region of the critical layer, but it gets energy from the 3D waves in the region further toward the channel center. This explains the distortion of the 2D wave at late times. Transitional flow was

also studied in the presence of an oscillatory pressure gradient. Mean flow oscillations are generally stabilizing. A discrepancy was resolved in the linear theory and an appropriate frequency parameter was determined for transitional flows. Dissert. Abstr.

N88-25851# Lawrence Livermore National Lab., Calif.
INVESTIGATION OF ROSSBY-NUMBER SIMILARITY IN THE NEUTRAL BOUNDARY LAYER USING LARGE-EDDY SIMULATION
W. D. Ohmstede, R. T. Cederwall, and R. E. Meyers Jan. 1988 4 p Presented at the 8th Symposium on Turbulence and Diffusion of the American Meteorological Society, San Diego, Calif., 1 Apr. 1988
(Contract W-7405-eng-48)
(DE88-008910; UCRL-97853; CONF-880463-2) Avail: NTIS HC A02/MF A01

Of particular interest is the steady-state, horizontally homogeneous, autobarotropic (PLB), hereafter referred to as the neutral boundary layer (NBL). The NBL is in fact a rare atmospheric phenomenon, generally associated with high-wind situations. Nevertheless, there is a disproportionate interest in this problem because Rossby-number similarity theory provides a sound approach for addressing this issue. Rossby-number similarity theory has rather wide acceptance, but because of the rarity of the true NBL state, there remains an inadequate experimental database for quantifying constants associated with the Rossby-number similarity concept. Although it remains a controversial issue, it has been proposed that large-eddy simulation (LES) is an alternative to physical experimentation for obtaining basic atmosphere data. The objective of the study is to investigate Rossby-number similarity in the NBL using LES. Previous studies have not addressed Rossby-number similarity explicitly, although use was made of it in the interpretation of results. The intent is to calculate several sets of NBL solutions that are ambiguous relative to their respective Rossby numbers and compare the results for similarities. DOE

N88-25852# Lawrence Livermore National Lab., Calif.
A DOMAIN DECOMPOSITION METHOD FOR BOUNDARY LAYER PROBLEMS
G. Rodrigue and E. Reiter 17 Mar. 1988 9 p Presented at the 2nd International Symposium on Domain Decomposition Methods, Los Angeles, Calif., 14 Jan. 1988 Prepared in cooperation with California Univ., Davis; and California State Univ., Hayward
(Contract W-7405-eng-48)
(DE88-008917; UCRL-98467; CONF-880179-1; CONF-880179) Avail: NTIS HC A03/MF A01

In this paper we analyze the behavior of a specific domain decomposition technique for solving a boundary value problem. We are concerned primarily in problems where the boundary conditions yield ordinary and parabolic boundary layers in the solution. The global domain is decomposed into subdomains according to the particular layers and the global solution is obtained by piecing together the different subdomain solutions. An algorithm for locating the layers and consequently the subdomains will be constructed. Numerical results will be presented. DOE

N88-25853# Argonne National Lab., Ill. Materials and Components Technology Div.
PRESSURE DROP AND HEAT TRANSFER IN TURBULENT NON-NEWTONIAN PIPE FLOW OF ADVANCED ENERGY TRANSMISSION FLUIDS
U. S. Choi, K. V. Liu, and K. E. Kasza 1988 16 p Presented at the International Conference on Advanced Science and Technology, Chicago, Ill., 19 Mar. 1988
(Contract W-31-109-eng-38)
(DE88-010021; CONF-8803102-1) Avail: NTIS HC A03/MF A01

Argonne National Laboratory (ANL), under sponsorship of the U.S. Department of Energy, is making significant progress on the development of advanced energy transmission fluids for thermal systems, in particular district heating and cooling systems. ANL has identified two concepts for developing advanced energy transmission fluids. Tests have been conducted at ANL to prove these concepts. This paper presents experimental results and discusses the degradation behavior of linear polymer additives and the flow and heat transfer characteristics of non-melting slurry flows. The experimental data obtained in this study provide support for the use of friction reducing additives and slurries in thermal system applications. DOE

N88-25854*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE SOLUTION OF THE ELROD ALGORITHM FOR A DYNAMICALLY LOADED JOURNAL BEARING USING MULTIGRID TECHNIQUES
Claudia M. Woods and David E. Brewe (Army Aviation Research and Development Command, Cleveland, Ohio.) 1988 31 p Proposed for presentation at the 1988 Tribology Conference, Baltimore, Md., 16-19 Oct. 1988; sponsored by ASME and STLE
(NASA-TM-100941; E-4222; NAS 1.15:100941; AVSCOM-TR-88-C-006) Avail: NTIS HC A03/MF A01 CSCL 13I

A numerical solution to a theoretical model of vapor cavitation in a dynamically loaded journal bearing is developed utilizing a multigrid iteration technique. The method is compared with a noniterative approach in terms of computational time and accuracy. The computational model is based on the Elrod algorithm, a control volume approach to the Reynolds equation which mimics the Jakobsson-Floberg and Olsson cavitation theory. Besides accounting for a moving cavitation boundary and conservation of mass at the boundary, it also conserves mass within the cavitated region via a smeared mass or striated flow extending to both surfaces in the film gap. The mixed nature of the equations (parabolic in the full film zone and hyperbolic in the cavitated zone) coupled with the dynamic aspects of the problem create interesting difficulties for the present solution approach. Emphasis is placed on the methods found to eliminate solution instabilities. Excellent results are obtained for both accuracy and reduction of computational time. Author

N88-25855# Sandia National Labs., Albuquerque, N. Mex.
NAVIER-STOKES CODE NS3D FOR BLUNT BODIES. PART 1: ANALYSIS, RESULTS AND VERIFICATION
F. G. Blottner and D. E. Larson Mar. 1988 78 p
(Contract DE-AC04-76DP-00789)
(DE88-010105; SAND-88-0504/1) Avail: NTIS HC A05/MF A01

A Navier-Stokes code for calculating the laminar or turbulent flow over blunt bodies in supersonic flow has been developed from a transonic flow code. The unsteady thin-layer form of the governing equations for a perfect gas are solved with a linearized block Alternating-Direction Implicit finite-difference solution procedure. Sensitivity of the solutions to code input parameters is investigated. Predictions obtained from the code are presented and compared to numerical and experimental results. This study indicates that very accurate surface pressures and reasonably accurate heat transfer predictions are obtained from the code. DOE

N88-25856*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A NAVIER-STOKES SOLVER FOR CASCADE FLOWS Final Report
A. Arnone and R. C. Swanson Jul. 1988 29 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181682; ICASE-88-32; NAS 1.26:181682) Avail: NTIS HC A03/MF A01 CSCL 20D

A computer code for solving the Reynolds averaged full Navier-Stokes equations has been developed and applied using sheared H-type grids. The Baldwin-Lomax eddy-viscosity model is used for turbulence closure. The integration in time is based on an explicit four-stage Runge-Kutta scheme. Local time stepping, variable coefficient implicit residual smoothing, and a full multigrid method have been implemented to accelerate steady state

calculations. Comparisons with experimental data show that the code is an accurate viscous solver and can give very good blade-to-blade predictions for engineering applications in less than 100 multigrid cycles on the finest mesh. Author

N88-25857*# Flow Research, Inc., Kent, Wash.
DIRECT SIMULATIONS OF CHEMICALLY REACTING TURBULENT MIXING LAYERS, PART 2 Final Report
Ralph W. Metcalfe, Patrick A. McMurtry, Wen-Huei Jou, James J. Riley, and Peyman Givi Jun. 1988 61 p
(Contract NAS3-24229)
(NASA-CR-180853; NAS 1.26:180853; Flow-RR-425) Avail: NTIS HC A04/MF A01 CSCL 20D

The results of direct numerical simulations of chemically reacting turbulent mixing layers are presented. This is an extension of earlier work to a more detailed study of previous three dimensional simulations of cold reacting flows plus the development, validation, and use of codes to simulate chemically reacting shear layers with heat release. Additional analysis of earlier simulations showed good agreement with self similarity theory and laboratory data. Simulations with a two dimensional code including the effects of heat release showed that the rate of chemical product formation, the thickness of the mixing layer, and the amount of mass entrained into the layer all decrease with increasing rates of heat release. Subsequent three dimensional simulations showed similar behavior, in agreement with laboratory observations. Baroclinic torques and thermal expansion in the mixing layer were found to produce changes in the flame vortex structure that act to diffuse the pairing vortices, resulting in a net reduction in vorticity. Previously unexplained anomalies observed in the mean velor , profiles of reacting jets and mixing layers were shown to result from vorticity generation by baroclinic torques. Author

N88-25858*# National Aeronautics and Space Administration, Washington, D.C.
AMMONIA BOILING IN LONG TUBES. HEAT TRANSFER AND CHARGE LOSS IN VERTICAL AND HORIZONTAL TUBES
A. Malek and R. Colin Aug. 1988 68 p Transl. into ENGLISH of Ebullition de lAmmoniac en Tube Long. Transfert de Chaleur et Pertes de Charges en Tubes Vertical et Horizontal, Senlis (France), p 1-65 Original language document was announced as N84-31588 Transl. by SCITRAN, Inc., Santa Barbara, Calif. Original document was prepared by Centre Tecnique des Industries Mecaniques
(Contract NASw-4307)
(NASA-TT-20313; NAS 1.77:20313; CETIM-14-C-011) Avail: NTIS HC A04/MF A01 CSCL 20D

Heat exchange and charge loss inside tubes carrying boiling ammonia, such as those found in nuclear power stations, were studied in the temperature range from 30 to 70 C. Mass flow, thermal load, and saturation pressure were investigated. For charge loss during two phase flow, an expression for the weight of a liquid-vapor mix column agrees with the experiments. Flow rate is not significant in either vertical or horizontal pipes. Author (ESA)

N88-25565# Drexel Univ., Philadelphia, Pa. Dept. of Mechanical Engineering and Mechanics.
ATOMIZATION IN A TURBULENT SHEAR LAYER: PRELIMINARY MEASUREMENTS
A. M. Mellor, S. Marakovits, K. V. Tallio, and B. Farouk *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 119-126 (For primary document see N88-25554 19-28)
(Contract DAAG29-84-K-0165)
Avail: NTIS HC A17/MF A01 CSCL 20D

N88-25569*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DUAL STOKES CARS MEASUREMENTS IN SUPERSONIC COMBUSTING FLOW
Olin Jarrett, Jr., Richard R. Antcliff, Tawit Chitsomboon, Glenn S. Diskin, and Andrew D. Cutler (George Washington Univ., Hampton, Va.) *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 171-178 (For primary document see N88-25554 19-28)
Avail: NTIS HC A17/MF A01 CSCL 21B

N88-25582*# Remtech, Inc., Huntsville, Ala.
BOUNDARY LAYER SIMULATOR (BLIMPJ) IMPROVEMENT
S. C. Praharaj and C. P. Schmitz *In* Johns Hopkins Univ., The 24th JANNAF Combustion Meeting, Volume 2 Oct. 1987 p 329-338 (For primary document see N88-25554 19-28)
(Contract NAS8-36551)
Avail: NTIS HC A17/MF A01 CSCL 20D

N88-25634# National Aerospace Lab., Tokyo (Japan).
FINITE ELEMENT ANALYSIS OF INCOMPRESSIBLE VISCOUS FLOW AROUND MULTI-ELEMENT AEROFOILS
Masashi Shigemi *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 29-35 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25635# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.
NUMERICAL SIMULATIONS OF ASTROPHYSICAL JETS
Takuya Matsuda, Ryuji Ishii, Yoshikuni Umeda, Atsuhiko Yasuda, Keisuke Sawada, and Eiji Shima (Kawasaki Heavy Industries Ltd., Kagamihara, Japan) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 37-42 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25650# National Aerospace Lab., Tokyo (Japan).
NUMERICAL ANALYSIS OF THREE DIMENSIONAL CASCADE FLOW BY SOLVING NAVIER-STOKES EQUATIONS
Osamu Nozaki, Kazuhiro Nakahashi, and Atsuhiro Tamura *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 147-156 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25651# Tokyo Metropolitan Univ. (Japan). Coll. of Aeronautical Engineering.
SIMULATION OF AXISYMMETRIC FLOW WITH H2O2 REACTIONS
Shizui Watanabe *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 157-160 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25652# National Aerospace Lab., Tokyo (Japan).
NUMERICAL ANALYSIS OF DUCT FLOW USING THREE-DIMENSIONAL PARABOLIZED NAVIER-STOKES EQUATION
Kazuo Kikuchi and Atsuhiro Tamura *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 161-168 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25653# Kawasaki Heavy Industries Ltd., Kagamihara (Japan).
THE ROLE OF COMPUTATIONAL FLUID DYNAMICS IN AERONAUTICAL ENGINEERING (5). IMPROVEMENTS AND APPLICATIONS OF IMPLICIT TVD FINITE VOLUME CODE
Eiji Shima, Kenji Yoshida, and Kanichi Amano (Japan Aircraft Development Corp., Tokyo.) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 169-175 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25654# Mitsubishi Heavy-Industries Ltd., Nagasaki (Japan).
EXTENSIVE VERIFICATION OF BLADE-TO-BLADE FLOW CODE BASED ON DENTON SCHEME
Tomihiko Sato, Sunao Aoki, and Hedetaka Mori *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 177-181 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25655# Ishikawajima-Harima Heavy Industries Co. Ltd., Mizuho (Japan).
APPLICATION OF COMPUTATIONAL FLUID DYNAMICS TO DESIGN OF COMPRESSOR CASCADE
Teiichi Tamaki, Kaoru Chiba, Atsushi Shimizu, and Kenji Kobayashi *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 183-189 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25656# Kawasaki Heavy Industries Ltd., Kakamigahara (Japan).
ON THE ACCURACY OF UPWIND BIASED FINITE VOLUME METHOD
Keisuke Sawada and Susumu Takanashi *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 191-195 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25657# National Aerospace Lab., Tokyo (Japan).
AN IMPLICIT, HIGH ORDER ACCURATE, UPWIND SCHEME FOR UNSTEADY EULER EQUATIONS
Kenichi Matsuno *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 197-200 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25659# National Aerospace Lab., Tokyo (Japan).
ON SYMMETRIC TVD SCHEMES Abstract Only
Takayuki Aki *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 209 (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25660# Fujitsu Ltd., Tokyo (Japan).
ON THE STATIONARY SOLUTIONS OF THREE-DIMENSIONAL EULER EQUATIONS BY THE TVD DIFFERENCE SCHEMES
Yoko Takakura, Tomiko Ishiguro, and Satoru Ogawa (National Aerospace Lab., Tokyo, Japan) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 211-216 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25661# National Aerospace Lab., Tokyo (Japan).
NUMERICAL SIMULATION OF TRANSITION TO TURBULENCE IN PLANE POISEUILLE FLOW BY A SPECTRAL METHOD
Kiyoshi Yamamoto and Iwao Hosokawa (Iwate Univ., Morioka, Japan) *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 217-232 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25662# Ministry of Transportation, Tokyo (Japan). Ship Research Inst.
NUMERICAL SIMULATION OF TURBULENT FLOW USING THE EXPONENTIAL EXPRESSION OF k-EPSILON EQUATION
Munehiko Hinatsu and Yoshiaki Kodama *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 225-232 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25663# Chiba Univ. (Japan). Faculty of Engineering.
RELAXATION SCHEME FOR COMPRESSIBLE FLOWS
Nobuhide Nishikawa and Akira Suzuki *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 233-239 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25664# Keio Univ., Yokahama (Japan). Faculty of Science and Technology.
THE MODIFIED-FLUID-IN-CELL METHOD TO WHICH ADAPTIVE MESH AND MULTIGRID WERE APPLIED
Ikuo Ono, Kentaro Motoda, Eriya Kanai, and Tsuneyo Ando *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynammics Nov. 1987 p 241-246 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N88-25859 New South Wales Univ., Sydney (Australia). Dept. of Physical Chemistry.
A MASS SPECTROMETER FOR THE ANALYSIS OF THERMALLY LABILE COMPOUNDS Ph.D. Thesis. Abstract Only
Peter George Cullis May 1987 149 p
Avail: Issuing Activity

A large, double-focussing mass spectrometer was constructed to allow analysis of ions of masses greater than 7,000 u. The feasibility of the detection of ions possessing masses of this order, using field desorption ionization, was demonstrated with the aid of a synthetic polymer, polypropylene glycol. The mass spectra have demonstrated the wide range of thermally labile compounds to which the field desorption techniques may be applied. Of particular interest was the affinity of cationic and neutral metal complexes to the field desorption method of ionization. The application of field desorption to a sophisticated binuclear copper complex clearly indicates the potential of the method in the study of sensitive, metal containing compounds of biological origin. Infrared laser assisted methods of field desorption ionization were developed and show promise for providing stable ion currents for mass spectroscopy. Pulsed laser induced field desorption was demonstrated as a method by which fragmentation of field desorbed ions may be promoted. With refinement this technique, in association with a large mass spectrometer and collision induced dissociation, could provide a powerful additional diagnostic tool for the study of molecules of biological interest. Author

N88-25860# Novasensor, Santa Clara, Calif.
THE 1986 IEEE SOLID-STATE SENSOR WORKSHOP Final Report, 2 Jun. 1986 - 1 Jun. 1987
Kurt E. Petersen 1986 124 p Workshop held in Hilton Head, S.C., 1-5 Jun. 1986
(Contract DAAL03-86-G-0161)
(AD-A190922; ARO-24383.1-EL-CF) Avail: NTIS HC A06/MF A01 CSCL 09A

Substantial efforts by the program committee and by all of the

authors and panelists ensure that the program and these proceedings contain many valuable contributions to the state-of-the-art in solid state sensors. These multidisciplinary interactions are one of the most stimulating aspects of current solid state sensor research. The workshop was divided into several discussion areas: Polysilicon and new micromachined structures; Chemical sensors; Sensing techniques and analysis; Sensor packaging and commercial production; Chemical sensors - 2; and Resonant and thin film sensing structures. For individual titles, see N88-25861 through N88-25899.

N88-25861# Fraunhofer-Inst. fuer Festkoerpertechnologie, Munich (West Germany).
CHARACTERISTICS OF POLYSILICON LAYERS AND THEIR APPLICATION IN SENSORS **c76**
E. Obermeier, P. Kopystynski, and R. Niessl *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 4 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 20L

The important characteristics of boron doped LPCVD polysilicon layers with regards to sensor applications are presented. Properties such as the resistivity, temperature coefficient of the resistance, gauge factor, and long term stability are described. A pressure sensor utilizing polysilicon piezoresistors with a measurement range of 1 bar and a sensitivity of roughly 11 mV/V F.S. is discussed. Finally, a polysilicon temperature sensor with on chip linearity error of less than 0.5 percent is described. Author

N88-25862# Wisconsin Univ., Madison. Center for Applied Microelectronics.
DESIGN AND CONSTRUCTION TECHNIQUES FOR PLANAR POLYSILICON PRESSURE TRANSDUCERS WITH PIEZORESISTIVE READ-OUT Abstract Only **c76**
H. Guckel, D. W. Burns, and C. R. Rutigliano *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 20L

Fabrication methods were finalized for vacuum sealed piezoresistive pressure tranducers that involve a polysilicon diaphragm which is reactive sealed using a low strain LPVCD silicon nitride layer. The nitride is also used for dielectric isolation of polysilicon strain sensors which are formed from a second polysilicon film. A stable, high yield processing sequence was achieved. Resistor data and mechanical data are combined to determine resistor placement. At least two design constraints occur: a fully active bridge configuration and the need to minimize the influence of optical alignment tolerances. A design algorithm accounts for both problems. These constraints are discussed.
Author

N88-25863# California Univ., Berkeley. Dept. of Electrical Engineering and Computer Sciences.
INTEGRATED POLYSILICON TACTILE SENSOR **c76**
A. K. Oki and R. S. Muller *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p Sponsored in part by the State of California MICRO Program (For primary document see N88-25860 19-35)
(Grant NSF ECS-81-20562)
Avail: NTIS HC A06/MF A01 CSCL 20L

A polysilicon tactile sensor that is sensitive to tangential force was designed, fabricated, and tested. Microfabrication of silicon is employed to create a sensor that has a linear response of 465 mV N(-1) of tangential force over a force range of + or - 6.25 mN. The minimum resolvable tangential force is 42 micro-N.
Author

N88-25864# Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Solid State Electronics.
A MONOLITHIC GAS FLOW SENSOR WITH POLYIMIDE AS THERMAL INSULATOR
Goeran N. Stemme *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 14B

A novel small monolithic gas flow sensor was designed and fabricated by use of micromachining of silicon. Its operation is based on the cooling of an electrically heated mass by the gas flow, and detection of the mass's temperature by a diode. The small size, 0.4 mm by 0.3 mm by 30 microns, of the hot part of the sensor gives a fast thermal response (50 ms). By using polyimide as a thermal insulator, a high gas flow sensitivity is achieved. The shape of the sensor will present very little obstruction to the gas flow and also make it easy to mount. Author

N88-25865# Stanford Univ., Calif.
MICROMINIATURE FLUIDIC AMPLIFIER
Mark J. Zdeblick, Phillip W. Barth, and James B. Angell *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p (For primary document see N88-25860 19-35)
(Contract JPL-956888; Grant GM-43-5)
Avail: NTIS HC A06/MF A01 CSCL 14B

A microminiature fluidic amplifier with vertical walled features 6 micron wide and 35 micron deep was fabricated in silicon using dry anisotropic etching. Operation was demonstrated using nitrogen as the working fluid. The dc gains greater than unity were seen over a supply pressure range of 10 to 80 psi. The amplifier is intended to be used as a circuit element in integrated fluidic circuits or, together with onboard electronics, as part of a transducer system. Dry etching techniques similar to those used here offer new opportunities for the micromachining of integrated sensors and actuators. Author

N88-25866# Massachusetts Inst. of Tech., Cambridge.
ELECTRICAL AND CHEMICAL SENSORS FOR BIOLOGICAL CELL RESEARCH
D. J. Edell, V. M. McNeil, M. G. Curley, and J. H. Wolfe *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p (For primary document see N88-25860 19-35)
(Grant NIH-NCI-CA-37235)
Avail: NTIS HC A06/MF A01 CSCL 14B

Electrical and chemical microsensors for biological cell research allow for the continuous study of biological systems under normal physiological conditions. Two sensor technologies which take most advantage of microfabrication technology are discussed. One is being developed for monitoring the environment of cancer cells during radiotherapy, chemotherapy, and hyperthermia treatment. Of current interest is the measurement of temperature and interstitial free oxygen concentration distributions in cancer tissues prior to and during various treatments. The second technology discussed is being developed for monitoring the extracellular ionic currents from electrogenic cells in culture. The ability to build integrated circuits over large areas of a silicon wafer which can impedance transform the signals and multiplex a large array of contacts is being used. Author

N88-25867# Signal Research Center, Inc., Des Plaines, Ill.
CHARACTERIZATION OF PROTON CONDUCTING POLYMER BLENDS **c27**
S. Petty-Weeks and A. J. Polak *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 4 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 11B

The proton conducting polymer blend of poly(vinyl alcohol) and phosphoric acid was modeled using ac impedance techniques. Evidence indicates the presence of a separate phosphoric acid/water phase which is responsible for the proton conduction of the film. This is supported by differential scanning calorimetry, dielectric, and conductivity measurements. Conductivity versus temperature plots show Arrhenius-like behavior rather than the free volume type behavior associated with ion transport mechanisms dependent on polymer motion. Author

N88-25868# Johnson Controls, Inc., Milwaukee, Wis.
PYROLYZED ORGANIC POLYMER NITROGEN DIOXIDE SENSOR

J. O. Colla *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 14B

The element described for sensing the presence of nitrogen dioxide in the environment consists of a pyrolyzed polyaromatic polymer film having semiconductive properties. Nitrogen dioxide effects a change in the electrical resistance of the pyrolyzed polymer. The presence of nitrogen dioxide causes the electrical resistance of the element to decrease, and the magnitude of resistance change is a function of nitrogen dioxide concentration. Concentrations as low as 1.3 ppm nitrogen dioxide can be readily and quickly sensed in an air environment. Author

N88-25869# Stanford Univ., Calif. Electronic Labs.
CHEMICAL MULTISENSORS WITH SELECTIVE ENCAPSULATION OF ION-SELECTIVE MEMBRANES
Felix J. Schwager, Luc J. Bousse, Lyn Bowman, and J. D. Meindl *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 14B

Chemical sensors fabricated with simultaneous wafer scale encapsulation of ion selective electrode mambranes are described. The sensors are miniature ion selective electrodes in chambers located on a silicon substrate. These chambers are made by anodically bonding to the silicon a no. 7740 pyrex glass wafer in which cavities were drilled. Pores with dimensions selectable from 50 microns upwards are opened in the roofs of the chambers by drilling with a CO2 laser. Each sensor die contains four cavities which are filled under reduced pressure with liquid membrane material which is subsequently polymerized. The transducers on the cavity floor are Ag/AgCl electrodes. Interconnects between the sensor chambers on each die and bonding pads are made in the silicon substrate. Author

N88-25870# EOTec Corp., West Haven, Conn.
FIBER OPTIC SENSORS
David A. Krohn *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 4 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 14B

Fiber optic sensors are being widely used in digital applications for switches and counters. Applications are expanding to include temperature, pressure and liquid level switches. Analog fiber optic intensity modulated sensors are being used in a number of trial applications. Analog sensors still have a number of deficiencies including lightsource variations, microbending of optical leads and connector losses. Author

N88-25871# Sandia National Labs., Albuquerque, N. Mex. Microsensor Div.
OPTICAL SENSING OF MAGNETIC FIELDS **c74**
M. A. Butler and S. J. Martin *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 20F

The development of optical fiber technology has spurred the development of a wide range of optical sensors for many physical parameters. Interferometric sensors where the fiber is coated with a magnetic material are now capable of sensitivities in the microgauss range with potential for further improvement. These sensors, however, have bandwidths limited to the kilohertz range because of the nature of magnetostrictive coating materials. The recent development of new magnetic semiconductors which show very large Faraday rotations make possible moderately sensitive devices with very large bandwidths. The limitations on optical sensing of magnetic fields are explored using the Faraday effect imposed by the properties of the sensing material. Emphasis is given to factors limiting the bandwidth of these devices. Author

N88-25872# Pennsylvania Univ., Philadelphia. Center for Sensor Technologies.
ANOMALOUS EMISSIVITY FROM PERIODIC MICRO-MACHINED SILICON SURFACES Abstract Only **c76**
Peter J. Hesketh, Benjamin Gebhart, and Jay N. Zemel *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 1 p (For primary document see N88-25860 19-35)
(Grant NSF ECS-84-12241)
Avail: NTIS HC A06/MF A01 CSCL 20L

Thermal processes involving small micromachined surface elements have begun to attract an increased amount of attention. While much of the attention has been on cooling of integrated circuits, there remains a fundamental question about the nature of the interactions when the characteristic scale of the physical process becomes comparable to the dimensional scale of the local geometry. One of the simpler processes to investigate is the radiant heat transfer from a solid whose surface was micromachined to form a regular periodic structure, e.g., a deep grating or a two dimensional array of pits or hillocks. Such surfaces are referred to as microconfigured. They have potential applications as adsorbers of gases, absorbers of radiation, and microheat exchangers. The results reported are not only the first experimental study of the thermal emissivity of deep gratings, but is also a subject for which essentially no direct theoretical study has been performed. Resulting data demonstrated that surface geometry plays a highly important role in emissivity. Author

N88-25873# Gould, Inc., Oxnard, Calif. Measurement Systems Div.
STRESS MODELING OF MICRODIAPHRAGM PRESSURE SENSORS
P. C. Tack and H. H. Busta (Gould, Inc., Rolling Meadows, Ill.) *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 14B

A finite element program analysis was used to model the stress distribution of two monocrystalline silicon diaphragm pressure sensors. One configuration consists of an anisotropically backside etched diaphragm into a 250 micron thick, (100) oriented, silicon wafer. The diaphragm and total chip dimensions are given. The device is rigidly clamped on the back to a support substrate. Another configuration consists of a monocrystalline, (100), microdiaphragm which is formed on top of the wafer and whose area is reduced by a factor of 25 over the first configuration. The diaphragm is rigidly clamped to the silicon wafer. The stresses were calculated at a gauge pressure of 300 mm Hg and used to estimate the piezoresistive responses of resistor elements which were placed parallel and perpendicular near the diaphragm edges. Author

N88-25874# Stanford Univ., Calif. Dept. of Electrical Engineering.
NOISE IN PIEZORESISTIVE AND CAPACITIVE SENSORS
Richard R. Spencer, Bruce M. Fleischer, Phillip W. Barth, and James B. Angell *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p Sponsored in part by Ford Corp., National Inst. of Health and Bell Labs. (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 14B

An analysis was performed of the minimun resolvable input (MRI) for piezoresistive and capacitive pressure sensors as determined by fundamental noise mechanisms. Even though capacitive sensors have raw sensitivities that are of an order of magnitude or more higher than those of piezoresistive sensors, the MRI of piezoresistive sensors (ignoring temperature coefficients and offsets) can be much lower than that of comparable capacitive sensors. Piezoresistive sensors may thus be more promising than capacitive sensors for applications requiring a large dynamic range and/or small MRI. Author

N88-25875# General Motors Research Labs., Warren, Mich. Electronics Dept.
THERMAL MANAGEMENT OF INTEGRATED MICROSENSORS

Selden B. Crary *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 4 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 14B

Thermal modeling techniques are demonstrated as they apply to a generic integrated microsensor with a heat source located on an anisotropically etched silicon diaphragm. One and two dimensional conduction formulas, boundary layer convective heat transfer, a method of images approach for chip level conduction, and the finite element method are discussed, with examples, as they apply to the generic microsensor. Author

N88-25876# Honeywell Systems and Research Center, Minneapolis, Minn.
COMPARISON OF FIVE READOUT TECHNIQUES FOR AN INTEGRATED MAGNETOMETER
James Lenz, Ken Kawai, Richard Fryer, and Lee Strandjord *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 4 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 14B

Five readout techniques for an integrated permalloy magnetic sensor are investigated. Measurements of scale factor, minimum detectable signal, and long term stability are compared. Significant improvements using more complex modulation techniques are not readily attained over the commonly used dc readout method. Author

N88-25877# Bailey Controls Co., Wickliffe, Ohio.
SENSORS FOR PROCESS CONTROL REQUIREMENTS FOR DESIGN AND TEST
William L. Thompson *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 14B

Sensors for industrial process control have to meet many and varied requirements. The eventual specific applications may even be unknown to the designer and manufacturer as some industries are very close on details of their proprietary processes. Sensor research provides a new technique for quantifying a physical parameter. The task is then to identify it with a need in the marketplace and match the sensor with the requirements of the application. A process control sensor is rarely targeted for a single application. An awareness of the details of and breath of requirements may assist in the development process of a sensor that has eventual application in the process control marketplace. Author

N88-25878*# Stanford Univ., Calif. Center for Integrated Systems.
FLEXIBLE TACTILE SENSING ARRAYS FOR ROBOTICS: ARCHITECTURAL ROBUSTNESS AND YIELD CONSIDERATIONS
Phillip W. Barth, Mark J. Zdeblick, Zenon Kuc, and Patricia A. Beck *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p Sponsored by NASA, Ames Research Center, Moffett Field, Calif. (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 14B

No tactile sensor array developed to date fills all, nor even most, of the requirements of: (1) many sensor elements to minimize tactile imaging time, (2) close spacing of small sensing elements for fine spatial discrimination, (3) ability to be molded to a convex fingertip surface for taction on concave surfaces, (4) ability to sense both force and temperature in order to fully mimic biological touch, (5) tolerance to overscale forces without damage, and (6) graceful failure in use, i.e., functional survival of most of the array when part of it is damaged, well. Several investigators have recently developed tactile sensing arrays suitable for imaging shapes on hard flat surfaces, but not well suited for taction on curved surfaces. Others have developed single tactile sensors suitable for incorporation into arrays, which will probably prove uneconomical when large numbers of sensors are needed. Still others have developed flexible capacitive arrays suitable for use on curved surfaces but incapable of obtaining temperature or proximity data. A technology is being developed herein suitable to the achievement of all of the above goals, and to incrementally demonstrate useful steps toward those goals. Author

N88-25879# Transensory Devices, Inc., Fremont, Calif.
APPLICATION-SPECIFIC PACKAGING FOR CUSTOM MICROMECHANICAL STRUCTURES
S. C. Terry, J. H. Jerman, J. W. Knutti, and H. V. Allen *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

Modern design practices support the method of topdown system design. If a system includes a sensor element, the performance and cost targets for the sensor must be set during system design. When these targets preclude the use of a generic device, then an application specific device and package become necessary. The sensor design can then be studied and the degree of application specific packaging can be varied to best satisfy the system specifications. Recent examples show that inclusion of packaging aspects into the sensor itself result in higher performance systems than would be possible using generic packages. In the extreme case, the sensor becomes its own package. In all cases, the evaluation of the system cost/performance tradeoffs must include the total cost of the integrated packaging versus the discrete package. Author

N88-25880# Motorola, Inc., Chicago, Ill.
AN INTEGRATED ON-CHIP PRESSURE SENSOR FOR ACCURATE CONTROL APPLICATIONS Abstract Only
Joseph M. Staller and William S. Cumberledge *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 1 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

Recent developments in microprocessor technology have opened up entire new vistas for control and monitoring applications that had previously been either too costly or impractical from an engineering standpoint. In the past, pressure sensing has been largely accomplished using mechanical techniques of questionable reliability and often requiring complex, expensive electronic interface circuitry if a control function was to be included as part of the measurement. The introduction of semiconductor pressure increased reliability and reduced the cost, but these early units still had the need for off-chip temperature compensation and calibration. The transition from basic sensing element to integrated sensor has involved the blending of sophisticated micromachining techniques, thin film resistor technology and bipolar wafer processing, each with its own particular processing problems. The problems, and attendent solutions, that are addressed are: sensor technology, cavity etch, thin film resistor technology, laser trimming techniques, and amplifiers. Author

N88-25881# Sandia National Labs., Albuquerque, N. Mex.
ISOTHERMAL MEASUREMENT AND THERMAL DESORPTION USING SAW DEVICES
S. J. Martin, A. J. Ricco, and T. E. Zipperian *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p (For primary document see N88-25860 19-35)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A06/MF A01 CSCL 09A

The conventional implementation of surface acoustic wave (SAW) devices is departed from as gas sensors to describe how they may be used to measure adsorption isotherms and to perform thermal desorption spectroscopy. Adsorption isotherms are measurements, made at constant temperature, of surface coverage as a function of gas or vapor partial pressure for the species of interest. It was shown that by incorporating a heater as an integral part of a SAW device, a sensor can be constructed which is capable of measuring thermal desorption spectra. A greater spread in the temperatures at which molecules are desorbed, and thus greater discrimination between species, could be obtained by using coatings which form stronger chemical bonds rather than relying on physisorption. Author

N88-25882# Johnson Controls, Inc., Milwaukee, Wis.
THERMODYNAMIC STUDY OF HYGROSCOPIC POLYMERS USING SURFACE ACOUSTIC WAVES
John G. Brace, Thomas S. Sanfelippo, and Shrinivas G. Joshi (Marquette Univ., Milwaukee, Wis.) *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 4 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

In the course of developing a sensor for simultaneous humidity and temperature sensing, surface acoustic wave (SAW) transducers were investigated for use as tools in characterizing materials of interest in sensing applications. A computer controlled test system is reported for characterizing oscillator based sensors and the utility of SAW oscillator measurements is demonstrated for gaining insight into sorption processes in glassy polymers. Author

N88-25883# Katholieke Universiteit te Leuven (Belgium). Dept. Electrotechniek.
SILVER MULTI-LAYERS FOR PLANAR Ag/AgCl REFERENCE ELECTRODES **c33**
M. Lambrechts, J. Suls, and W. Sansen *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p Sponsored in part by IWONL and IMEC, Belgium (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

The behavior of different multilayers for silver microelectrodes is reported. Adhesion, lifetime and the use as a silver/silver chloride reference electrode for biomedical applications was investigated. The electrodes are incorporated in a planar CMOS process with a special lift off technique. The electrodes are used in the development of implantable glucose and oxygen sensors and ion selective electrodes. Author

N88-25884# National Bureau of Standards, Gaithersburg, Md.
THE STRUCTURE AND PROPERTIES OF RF REACTIVE SPUTTERED IrO2 FILMS **c33**
Kenneth G. Kreider *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

Iridium oxide films were reactively sputtered on alumina substrates at temperatures ranging from 300 to 600 K in order to relate the structure of the film to its electrical properties. X-ray diffraction of the films indicated a transition from an amorphous to crystalline structure with increasing temperature which was accompanied by an increasing electrical conductivity. Details on sputtering conditions, film adhesion, and structural characteristics of the films are also presented. Author

N88-25885# Illinois Univ., Chicago. Microelectronics Lab.
THE RESPONSE OF ULTRATHIN PALLADIUM GATE SENSORS TO HYDROGEN AND CARBON MONOXIDE
G. Jordan Maclay and Kevin W. Jelley *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

MOS sensors were made using gates of Pd that were 25 and 40 A thick. The resistance across the gate, as well as the gate to substrate capacitance showed sensitivity in air to CO at 180 C and to H2 at room or elevated temperatures. Author

N88-25886# Hawaii Univ., Honolulu. Physical Electronics Lab.
AIR LOADING EFFECTS ON A CAPACITIVELY SENSED MEMBRANE SUPPORTED SILICON ACCELEROMETER
Scot P. McArthur and James W. Holm-Kennedy *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

A capacitively coupled silicon accelerometer with the proof mass supported by a thin silicon membrane is described. The device offers convenient A/D conversion via conversion of acceleration to an oscillator frequency change. Air mass loading is shown to decrease the device sensitivity. The reduced sensitivity is attributed to the effect of air compressibility on the apparent membrane stiffness and air damping. Author

N88-25887# Sensym, Inc., Sunnyvale, Calif.
SIMULATION OF DIAPHRAGM-TYPE IC PRESSURE SENSORS
H. Reimann and Y. Fathi *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 4 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

Sensitivity calculations of monolithic, piezoresistive pressure sensor chips are presented. The stress analysis is based on a series expansion for the deflection of a clamped thin plate. These coefficients were determined with a least square fit to the results of a finite element analysis. Both square and rectangular diaphragms are modeled for materials with anisotropic elastic and piezoresistive properties. Averaging is performed over the area of extended piezoresistors. Experimental results are presented for bridge and shear elements. The agreement between measurement and simulation is excellent. Author

N88-25888# Alberta Univ., Edmonton. Dept. of Electrical Engineering.
CARRIER TRANSPORT IN SEMICONDUCTOR MAGNETIC SENSORS UNDER NONUNIFORM FIELDS **c76**
H. P. Baltes, W. Allegretto, A. Nathan, and Y. Sugiyama (Electrotechnical Lab., Tokyo, Japan) *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

Two dimensional numerical solutions are presented of carrier transport (comprising the electrostatic potential and current density) in semiconductor magnetic sensors in the presence of nonuniform, locally inverted induction. The variations in B and device geometries considered restrict the application of previous analytical methods. Results are illustrated by considering a split drain device structure and studying its response for various induction configurations. Author

N88-25889# Sandia National Labs., Albuquerque, N. Mex.
MINIATURE RADIATION DOSIMETER FOR IN VIVO RADIATION MEASUREMENTS
R. C. Hughes, D. Huffman, J. V. Snelling, T. E. Zipperian, A. J. Ricco, and C. A. Kelsey (New Mexico Univ., Albuquerque.) *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

The use of ionizing radiation from various sources for the treatment of tumors is widespread. There are no commercial devices for in vivo, real time, dosimetry of patients. The dose to be given a patient is determined from computer modelling and the calibration of the radiation sources. A miniature dosimeter which was mounted in a 1 mm catheter is described. The active device is a radiation sensing field effect transistor (RADFET) which can be used in either an active or passive mode. The RADFET in a catheter is designed to be used during implant radiation therapy of the breast, prostrate, cervix, among other modalities. Its use and operation is described. Author

N88-25890# Rutgers - The State Univ., Piscataway, N. J. Dept. of Electrical Engineering.
STEADY STATE AND TRANSIENT BEHAVIOR OF THE Pd-SnO(SUB x) MIS OXYGEN SENSORS
J. F. Xu, W. P. Kang, B. Lalevic, and T. Poteat (Bell Telephone Labs., Inc., Murray Hill, N. J.) *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

Results on the device characteristics of the O2 gaseous sensors are presented. These sensors are fabricated in the MIS configuration Pd-SnO sub x Si3N4-SiO2-Si-Al with highly resistive SnO sub x as oxygen adsorptive element. Partial pressure of O2 below 0.1 torr can be detected at room temperature by these

devices. Steady state and transient behavior are described as a function of O2 partial pressure and temperature. Adsorption and desorption rates and time constants are determined. Activation energy for O2 adsorption in SnO sub x is found to be 1.6 k cal/mol. Author

N88-25891# Case Western Reserve Univ., Cleveland, Ohio. Electronics Design Center.
JOINT ANGLE SENSORS FOR CLOSED-LOOP CONTROL
Wen H. Ko and Chih-Lei Miao *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

In order to substitute braces that have built-in goniometers and to provide feedback signals for closed loop control of lower extremity Functional Neuromuscular System in paraplegics, a stretchable capacitive sensor was developed to accurately detect angular movement in joints. Promising clinical evaluations on the knee joints of a paraplegic and a volunteer were done. The evaluations show great promise for the possibility of implantation applications. Author

N88-25892# Case Western Reserve Univ., Cleveland, Ohio. Electronics Design Center.
EFFECT OF PROCESS CONDITIONS ON ALUMINUM OXIDE THIN FILM USED IN pH ISFET **c27**
Anthony S. Wong and Peter W. Cheung *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 4 p Prepared in cooperation with Washington Univ., Seattle (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

Inorganic oxide material, such as alunimun oxide, may not give linear and stable pH response as predicted from the site binding model. Investigation of the relationship between process conditions and overall film properties is described. Pyrohydrolytic aluminum oxide exhibits very distinct microscopic structures under different process conditions. The TEM results show good correlation with the leakage current and the maximum dielectric breakdown strength. These findings are useful in augmenting pH ISFET sensor design. Author

N88-25893# Massachusetts Inst. of Tech., Cambridge. Microsystems Technology Labs.
RESONANT STRUCTURES FOR INTEGRATED SENSORS
Martin A. Schmidt and Roger T. Howe *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 4 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

Mechanically resonant microsensors are reviewed along with the design issues for this class of sensors. Rayleigh's Method is applied to determine the resonant frequencies of common microstructures, and insight is provided into the perturbation of the resonance in sensing applications. Resonant microsensors that measure mass loading and force or pressure are studied. A discussion is presented of some of the issues of importance in resonant microsensor design. Author

N88-25894# Sandia National Labs., Albuquerque, N. Mex.
SURFACE ACOUSTIC WAVE GAS SENSOR BASED ON FILM CONDUCTIVITY CHANGES
A. J. Ricco, S. J. Martin, and T. E. Zipperian *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p Previously announced in IAA as A86-40838 (For primary document see N88-25860 19-35)
(Contract DE-AC04-76DP-00789)
Avail: NTIS HC A06/MF A01 CSCL 09A

The first surface acoustic wave (SAW) sensor that functions via changes in conductivity of a thin surface film is reported. A lead phthalocyanine (PbPc) thin film is deposited on the acoustic propagation path of a LiNbO3 SAW delay line, which serves as the feedback element of an oscillator circuit. Reaction with strongly oxidizing gases, in particular NO2, increases the conductivity of the PbPc film. Acoustoelectic coupling of the traveling electric potential wave associated with the SAW-to-charge carriers in the PbPc film slows the acoustic wave velocity, altering the oscillation frequency of the circuit. This sensor is about 1000 times more sensitive, in terms of the number of NO2 molecules that can be detected (10 to the 16th molecules/cu cm of PbPc film), than an identical SAW sensor functioning via mass loading would be. Sensitivity to a few ppm of NO2 in Ne was demonstrated. Author

N88-25895# California Univ., Berkeley. Dept. of Electrical Engineering.
THIN-MEMBRANE LAMB-MODE ACOUSTIC OSCILLATORS FOR CHEMICAL DETECTION **c71**
Edward T. Zellers, Stuart W. Wenzel, Richard M. White, and Peter J. Wicher *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 4 p Sponsored in part by Chevron Research, Inc. and the State of California MICRO Project (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 20A

Using computer simulation, the response of polymer coated acoustic wave oscillators as chemical sensors was examined. Two structures were studied for comparison: a thin membrane ZnO on Si oscillator, and a conventional surface acoustic wave (SAW) oscillator, both operating at a wavelength of 141 microns. For changes in the physical properties of the polymer coating, that might occur upon exposure to chemicals, the velocity sensitivity of the thin membrane structure is typically an order of magnitude greater than that of the SAW structure. Approaches to the fabrication of these sensors are described. Author

N88-25896# California Univ., Berkeley. Dept. of Electrical Engineering.
ZINC-OXIDE THIN FILMS FOR INTEGRATED-SENSOR APPLICATIONS
D. L. Polla and R. S. Muller *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p Sponsored in part by the State of California MICRO Project (For primary document see N88-25860 19-35)
(Grant NSF ECS-81-20562)
Avail: NTIS HC A06/MF A01 CSCL 09A

Integrated sensors based on the piezoelectricity and pyroelectricity in zinc oxide thin films were fabricated compatibly with conventional NMOS technology. A study of material and electrical properties of the zinc oxide films, prepared by planar magnetron sputtering, was carried out. For 1 micron thick films, the measured piezoelectric coefficient is d sub 33 = 14.4 x 10 to the -12th power/CN and the pyroelectric coefficient is p sup sigma = 1.4 x 10 to the -9C sq cm/K. In practical integrated sensor designs, these films yielded voltage responses of 5.2 mV/gm (piezoelectric effect) and 150 mV/K (pyroelectric effect). Author

N88-25897# General Motors Research Labs., Warren, Mich. Electronics Dept.
TIN OXIDE MICROSENSORS ON THIN SILICON MEMBRANES
Shih-Chia Chang and David B. Hicks *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 4 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

Tin oxide based microsensors with integrated polysilicon heaters were fabricated on thin silicon membranes generated by anisotropic wet chemical etching using ethylene diamine pyrocatechol as the etchant. Good thermal isolation and lower power consumption were achieved. The sensing elements, tin oxide thin films, were prepared either by sputter deposition or by metallo-organic deposition. The completed microsensors showed good response to alcohol vapor and good stability of the integrated polysilicon heaters. Author

N88-25898# Wisconsin Univ., Madison. Center for Applied Microelectronics.
DEPOSITION TECHNIQUES AND PROPERTIES OF STRAIN COMPENSATED LPCVD SILICON NITRIDE FILMS
H. Guckel, D. K. Showers, D. W. Burns, C. R. Rutigliano, and C. G. Nesler (Johnson Controls, Inc., Milwaukee, Wis.) *In*

Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

Work on polysilicon transducers has shown that polysilicon resistors make acceptable strain sensors. Mechanical structures which promote lateral buckling were designed and were used to study the process controlled strain field in silicon nitride. Two views of the free standing U-shaped beams used in the analysis are shown. The strain field varies from highly tensile to compressive as the dichlorosilane/ammonia gas ratio increases. Processing conditions for films of a predetermined strain field and optical index were determined. Author

N88-25899# Massachusetts Inst. of Tech., Cambridge. Microsystems Technology Labs.
THE USE OF MICROMACHINED STRUCTURES FOR THE MANAGEMENT OF MECHANICAL PROPERTIES AND ADHESION OF THIN FILMS
Mehran Mehregany, Mark G. Allen, and Stephen D. Senturia *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p Sponsored in part by the Office of Naval Research, Washington, D.C., Du Pont de Nemours (E. I.) and Co., Wilmington, Del. and Minnesota Mining and Manufacturing Co., Minneapolis (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

The application of silicon micromachining to the measurement of mechanical properties of thin films such as intrinsic stress, Young's modulus, and adhesion is presented. The measurement is based on the deflection and subsequent peeling of suspended membrane sections of the film. The goal was to make a quantitatively reproducible adhesion test by applying micromachining techniques to the blister peel test described by Hinkley. The initial measurements demonstrated the importance of residual stress in the films, which resulted in an expanded emphasis on the basic mechanical properties of the membrane as a prelude to accurate adhesion measurements. The process for micromachining suspended membranes is discussed along with the theory leading to the determination of mechanical properties of the films, the results, and the present status of the adhesion work. Author

N88-25900*# National Aeronautics and Space Administration, Washington, D.C.
STUDIES OF ERROR IN TEMPERATURE MEASUREMENT WITH THERMISTORS IN THE RANGE BETWEEN CONTINUAL AND FREE-MOLECULE FLOWS
E. Asseng Jun. 1988 9 p Transl. into ENGLISH from Issledovaniya Poreshnosti Izmereniy Temperatury s Pomoshchyu Termistorov v Diapazone Mezhdu Kontinualnym i Svoboono Melekulyarnth Techeniyami (USSR), Gidrometeoizdat, 1987 p 256-262 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20302; NAS 1.77:20302) Avail: NTIS HC A02/MF A01 CSCL 14B

Simple interpolation formulas for the temperature recovery factor and the heat-transfer coefficient (Nusselt number) are derived for a sphere in the intermediate flow region. The results apply to bead thermistors intended for temperature measurements from rockets. Author

N88-25901*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A TWIN-MIRRORED GALVANOMETER LASER LIGHT SHEET GENERATOR
David B. Rhodes, John M. Franke, Stephen B. Jones, and Bradley D. Leighty Jun. 1988 28 p
(NASA-TM-100587; NAS 1.15:100587) Avail: NTIS HC A03/MF A01 CSCL 20E

A galvanometer mirror-based laser light sheet system has been developed for use in the Basic Aerodynamics Research Tunnel at NASA Langley. This system generates and positions single or multiple light sheets over aeronautical research models being tested in the low speed tunnel. This report describes a twin mirrored galvanometer laser light sheet generator and shows typical light sheet arrangements in use. With this system, illumination of smoke entrained in the flow over a delta wing model reveals the vortical flow produced by the separation of the flow at the leading edge of the model. The light sheet system has proven to be very adaptable and easy to use in sizing and positioning light sheets in wind tunnel applications. Author

N88-25902# Oak Ridge National Lab., Tenn.
EVALUATION OF THE ION TRAP MASS SPECTROMETER FOR POTENTIAL APPLICATION IN THE SPACE STATION
G. L. Glish and S. A. McLuckey Apr. 1988 166 p
(Contract DE-AC05-84OR-21400)
(DE88-008940; ORNL/TM-10751) Avail: NTIS HC A08/MF A01

This report describes preliminary experiments with an ion trap mass spectrometer, which were done to evaluate its potential for use in the environmental monitoring system of the proposed space station. The first section of the report describes various modes of operation of the instrument, discusses some of the present limitations, and discusses some of the potential solutions to these limitations. The next section discusses the experimental results obtained on sixteen compounds with particular emphasis on comparing these data to that expected from a standard mass spectrometer. The last section consists of a conclusion and comments on suggested future work. DOE

N88-25793# Picosecond Pulse Labs., Inc., Boulder, Colo.
COMPARISON OF SAMPLING OSCILLOSCOPES WITH LESS THAN 35 ps TRANSITION DURATIONS
James R. Andrews *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 92-94 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N88-25903# Los Alamos National Lab., N. Mex.
USE OF MAGNETIC MATERIALS IN EXCIMER LASER CIRCUITS
M. Vannini, R. Sze, and F. Hommeau (Consiglio Nazionale delle Ricerche, Florence, Italy) 1987 9 p Presented at the Lasers '87, Lake Tahoe, Nev., 7 Dec. 1987 Prepared in cooperation with Inst. de Mecanique des Fluides, Marseille (France); Consiglio Nazional e della Ricerche, Florence (Italy)
(Contract W-7405-eng-36)
(DE88-006449; LA-UR-88-657; CONF-871254-8) Avail: NTIS HC A02/MF A01

The use of saturating magnetic materials in laser excitation discharge systems is presented. Particular attention is given to the most important parameters of magnetic materials and to the analysis of some circuits such as single and multi-stage pulse compressor and pre-pulse isolation systems. DOE

N88-25904# Oak Ridge National Lab., Tenn.
INFRARED AND FAR-INFRARED LASER DEVELOPMENT FOR PLASMA DIAGNOSTICS AT OAK RIDGE NATIONAL LABORATORY
W. H. Casson, C. A. Bennett, L. K. Fletcher, H. T. Hunter, D. P. Hutchinson, J. Lee, C. H. Ma, R. K. Richards, and K. L. VanderSluis 1987 4 p Presented at Lasers '87, Lake Tahoe, Nev., 7 Dec. 1987 Prepared in cooperation with Midwest Technical, Inc., Oak Ridge, Tenn., North Carolina Univ., Asheville, Tennessee Technological Univ., Cookeville and Tennessee Univ., Knoxville
(Contract DE-AC05-84OR-21400)
(DE88-007262; CONF-871254-9) Avail: NTIS HC A02/MF A01

Three IR and FIR based diagnostics will be developed and installed on the Advanced Toroidal Facility (ATF) at ORNL. An

interferometer operating at 119 mu m will measure plasma density along 14 vertical chords across the plasma cross-section. A small-angle Thomson scattering experiment using a 10.6-mu m pulsed laser will determine the feasibility of measuring alpha particle distribution in a burning plasma. Plans are being developed for installing an FIR-based scattering experiment on ATF to measure density fluctuations. DOE

N88-25905# Brookhaven National Lab., Upton, N. Y.
PROGRESS TOWARD A SOFT X-RAY FEL
C. Pellegrini Sep. 1987 8 p Presented at the 9th International Free-Electron Laser Conference, Williamsburg, Va., 14 Sep. 1987
(Contract DE-AC02-76CH-00016)
(DE88-007669; BNL-40985; CONF-8709110-23) Avail: NTIS HC A02/MF A01

The recent successes in operating Free Electron Lasers (FELs) from the far infrared to the visible and near UV, together with a better understanding of the physics and technology of these systems, is leading us to explore again the possibility of using FELs to produce coherent radiation in the XUV region, at wavelength shorter than 100 nm. In this paper we derive a set of scaling laws, which we will use to study XUV FELs, to obtain their possible performance, and, most important, to determine the characteristics of the electron beam needed to drive the FEL. To build a XUV FEL there are two main issues that we must face: to obtain mirrors with large enough reflectivity to build an optical cavity in this wavelength range; to produce an electron beam with the energy, high density, and small momentum spread, required to produce large gain. DOE

N88-25906 Nippon Electric Co. Ltd., Tokyo (Japan).
PRECISE BEAM ALIGNMENT He-Ne LASER TUBES
H. Hara, K. Hoshi, and H. Ishihara 1987 4 p In JAPANESE Submitted for publication
(PB87-228334) Avail: NTIS HC E09/MF E01; copy not available from STI Facility CSCL 20E

Internal mirror He-Ne laser tubes with 632.8 nm are very popular lasers, used for printers, scanners, measurement, agriculture/construction, medical and various R and D purposes, because of their high quality visible beams, relatively low cost and easy maintenance. NEC has recently developed its new series He-Ne laser tubes which have precisely aligned output beam with regard to the tube axis and many other superior features compared to conventional He-Ne laser tubes. For their highly precise beam alignment, users can eliminate their elaborate alignment procedures in the system assembly and/or tube replacement. These new models are especially suitable for POS handheld scanners with their precise beam alignment and small size. An outline is given of the characteristics and design of these new series He-Ne tubes. Author

N88-25907# Los Alamos National Lab., N. Mex.
GENERATION OF COHERENT SOFT X-RAYS USING A SINGLE-PASS FREE-ELECTRON LASER AMPLIFIER
T. F. Wang, J. C. Goldstein, B. E. Newmam, and B. D. McVey 1987 9 p Presented at the International Symposium on Gyrotrone and Free Electron Laser, Chengdu, China, 1 Jun. 1987
(Contract W-7405-eng-36)
(DE88-009137; LA-UR-88-1215; CONF-870607-2) Avail: NTIS HC A02/MF A01

We consider a single-pass free-electron laser (FEL) amplifier, driven by an RF-linac followed by a damping ring for reduced emittance, for use in generating coherent light in the soft X-ray region. The dependence of the optical gain on electron-beam quality, studied with the three-dimensional FEL simulation code FELEX, is given and related to the expected power of self-amplified spontaneous emission. We discuss issues for the damping ring designed to achieve the required electron beam quality. The idea of a multipass regenerative amplifier is also presented. DOE

N88-25908# Measurement Concept Corp., Livermore, Calif.
DESIGN AND PRELIMINARY EVALUATION OF AN UNDERWATER LASER-BASED IMAGING SYSTEM
T. McRae, T. Kulp, D. Garvis, R. Kennedy, and T. Salmon Mar. 1988 14 p Presented at the SPIE's Technical Symposium on Optics, Electro-optics and Sensors, Orlando, Fla., 4 Apr. 1988 Prepared in cooperation with Lawrence Livermore National Lab., Calif. and Naval Sea Systems Command, Washington, D.C.
(Contract W-7405-eng-48)
(DE88-010560; UCRL-97468; CONF-880462-8) Avail: NTIS HC A03/MF A01

The design and preliminary evaluation of an underwater laser-based imaging system (UWLIS) being developed by the Lawrence Livermore National Laboratory for the Naval Sea Systems Command is described. The system is composed of a synchronously scanning argon-ion laser beam and a very narrow (4 milliradian) field-of-view detector. The laser beam and detector field of view are separated at the imaging system, but converge at the target to reduce the common optical scattering volume. The system produces a standard real-time TV image and has a predicted range of 100 m for 5 watts of laser power. The results of evaluations conducted in a 15-m deep tank at the Naval Coastal Systems Center are presented and discussed. The performance of the UWLIS in various turbid water conditions is compared to typical low-light-level underwater TV systems. DOE

N88-25909# Sandia National Labs., Albuquerque, N. Mex.
SYSTEMATICS OF EXCIMER LASER ABLATION: THIN FILM PREPARATION OF HIGH T(SUB c) MATERIAL
R. A. Neifeld, S. Gunapala, G. Liang, S. A. Shaheen, M. Croft, J. Price, D. Simons, W. T. Hill, III, D. Ginley, and R. Pfeffer et al. 1988 18 p Presented at the 4th Northeast Regional Meeting on Processing and Applications of High T(sub c) Superconductors, New Brunswick, N.J., 9 May 1988
(Contract DE-AC04-76DP-00789)
(DE88-010569; SAND-88-1396C; CONF-880519-1; CONF-880519) Avail: NTIS HC A03/MF A01

Excimer laser ablation was used to prepare thin films from bulk targets of Y-Ba-Cu-O, Sm-Ba-Cu-O, and Bi-Sr-Ca-Cu-O. The systematic variation in film thickness, stoichiometry, and microstructure, as a function of laser fluence and angle from the target surface normal was determined. At laser fluence above a few J sq cm the film composition is uniform over wide solid angles. Deposition rate increases with laser fluence. For the Sm and Bi based materials film stoichiometry replicates the target composition at high laser fluence. These results can be understood in terms of the sudden creation of a dense gas layer at the target surface, and unity sticking coefficients at the substrate. The Y based films, however, are deficient in Ba and Cu at such laser fluence. The effect of moderate temperature processing upon interface sharpness for GaAs and Si based substrates and several of the high T sub c materials was investigated. DOE

N88-25910# Los Alamos National Lab., N. Mex.
APPLICATION OF PULSE COMPRESSION AND SHAPING TO THE FEL PHOTOELECTRIC INJECTOR
D. C. Nguyen, D. E. Watkins, and M. E. Weber 1988 16 p Presented at SPIE O-E Lase '88: Optoelectronics and Laser Applications in Science and Engineering, Los Angeles, Calif., 10 Jan. 1988
(Contract W-7405-eng-36)
(DE88-007908; LA-UR-88-696; CONF-880110-25) Avail: NTIS HC A03/MF A01

We discuss the application of self-phase modulation and grating pulse compression to the generation of temporally trapezoidal optical pulses for controlling the electron beam emittance and energy spread in an FEL photoelectric injector. Pulse compression in a single-stage pulse compressor, with background reduction based on the nonlinear birefringence of the optical fiber, yields 3-ps, compressed pulses without background pedestals or sidelopes. Trapezoidal, flat-topped pulses with 20-ps FWHM and 4-ps risetime have been obtained through self-phase modulation and group-velocity dispersion of the 3-ps pulses in a second fiber. Pulse shaping through Fourier transform amplitude and phase masking in the frequency domain and the amplification of the trapezoidal pulses are also discussed. DOE

N88-25645# Nissan Motor Co. Ltd., Tokyo (Japan).
A NUMERICAL ANALYSIS OF FLOW CHARACTERISTICS IN LASER PROPULSION SYSTEM
Toru Shimada and Takashi Abe (Tokyo Univ., Japan) *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 109-114 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25796# Tektronix, Inc., Beaverton, Oreg.
ENERGY VARIATIONS IN OPTICAL PULSES FROM GAIN-SWITCHED AlGaAs DIODE LASERS
R. T. Hawkins, J. H. Goll, and N. A. Anheier *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 100-102 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25797# Bell Telephone Labs., Inc., Holmdel, N. J.
CHARACTERISTICS, PACKAGING AND PHYSICS OF ULTRA HIGH SPEED DIODE LASERS AND DETECTORS
J. E. Bowers and C. A. Burrus *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 104-106 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25798# Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Electrical Engineering.
FREQUENCY CHIRPING IN PULSE MODULATED GAIN AND REAL INDEX GUIDED SINGLE QUANTUM WELL LASERS
A. Larsson, P. Andersson, and A. Yariv (California Inst. of Tech., Pasadena.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 107-109 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25800# Bell Telephone Labs., Inc., Holmdel, N. J.
PICOSECOND MEASUREMENTS OF GAIN-SWITCHING IN A SEMICONDUCTOR LASER DRIVEN BY ULTRASHORT ELECTRICAL PULSES
P. M. Downey, J. E. Bowers, R. S. Tucker, and J. M. Wiesenfeld *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 113-115 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N88-25911# Caterpillar Tractor Co., Peoria, Ill.
DIRECT GAS INJECTION WITH GLOW PLUG IGNITION Final Report, Aug. 1986 - Jul. 1987
B. G. Richards Aug. 1987 49 p
(Contract GRI-5086-293-1336)
(PB88-187323; GRI-88/0026) Avail: NTIS HC A03/MF A01 CSCL 13I

The objective of the work was to show that direct natural gas injection with glow plug ignition assist offers potential for allowing natural gas engines to increase specific power output and thermal efficiency to levels comparable to diesel engines. These potential improvements result from changing the current homogeneous-charge, carburetted Otto cycle gas engines to a direct gas injected diesel cycle. Tests were conducted on a 5.4 inch bore single cylinder engine utilizing direct natural gas injection with glow plug ignition assist. The results show that direct natural gas injection with glow plug ignition assist can provide natural gas engines with specific power output and thermal efficiency (without gas compressor) equal to diesel engines. GRA

N88-25912*# Texas A&M Univ., College Station. Dept. of Mechanical Engineering.
AUTOMATIC CALIBRATION OF SPACE BASED MANIPULATORS AND MECHANISMS Final Report, 6 Jan. 1987 - 5 Jun. 1988
Louis J. Everett 1988 81 p
(Grant NAG9-192)
(NASA-CR-182804; NAS 1.26:182804) Avail: NTIS HC A05/MF A01 CSCL 13I

Four tasks in manipulator kinematic calibration are summarized. Calibration of a seven degree of freedom manipulator was simulated. A calibration model is presented that can be applied on a closed-loop robot. It is an expansion of open-loop kinematic calibration algorithms subject to constraints. A closed-loop robot with a five-bar linkage transmission was tested. Results show that the algorithm converges within a few iterations. The concept of model differences is formalized. Differences are categorized as structural and numerical, with emphasis on the structural. The work demonstrates that geometric manipulators can be visualized as points in a vector space with the dimension of the space depending solely on the number and type of manipulator joint. Visualizing parameters in a kinematic model as the coordinates locating the manipulator in vector space enables a standard evaluation of the models. Key results include a derivation of the maximum number of parameters necessary for models, a formal discussion on the inclusion of extra parameters, and a method to predetermine a minimum model structure for a kinematic manipulator. A technique is presented that enables single point sensors to gather sufficient information to complete a calibration. J.P.B.

N88-25913*# Texas A&M Univ., College Station. Research Foundation.
ENERGY DISSIPATION IN A ROLLING AIRCRAFT TIRE Semiannual Status Report No. 4, 1 Jan. - 30 Jun. 1988
John T. Tielking 1988 8 p
(Grant NAG1-644)
(NASA-CR-182978; NAS 1.26:182978) Avail: NTIS HC A02/MF A01 CSCL 13I

The project is extending an existing finite element tire model to calculate the energy dissipation in a free-rolling aircraft tire and temperature buildup in the tire carcass. The model will provide a means of calculating the influence of tire design on the distribution of tire temperature. Current focus is on energy loss measurements of aircraft tire material. The feasibility of taking test specimens directly from the tire carcass for measurements of viscoelastic properties was demonstrated. The interaction of temperature and frequency effects on material loss properties was studied. The tire model was extended to calculate the cyclic energy change in a tire during rolling under load. Input data representing the 40 by 14 aircraft tire whose material loss properties were measured are being used. J.P.B.

N88-25914# Oak Ridge National Lab., Tenn.
A CONCURRENT ON-BOARD VISION SYSTEM FOR A MOBILE ROBOT
J. P. Jones 1988 12 p Presented at the 3rd Conference on hypercube Concurrent Computers and Applications, Pasadena, Calif., 19 Jan. 1988
(Contract DE-AC05-84OR-21400)
(DE88-007475; CONF-880117-3) Avail: NTIS HC A03/MF A01

Robot vision algorithms have been implemented on an 8-node NCUBE-AT hypercube system onboard a mobile robot (HERMIES) developed at Oak Ridge National Laboratory. Images are digitized using a faremgrabber mounted in a VME rack. Image processing and analysis are performed on the hypercube system. The vision system is integrated with robot navigation and control software, enabling the robot to find the front of a mockup control panel, move up to the panel, and read an analog meter. Among the concurrent algorithms used for image analysis are a new component labeling algorithm and a Hough transform algorithm with load balancing. DOE

N88-25915# Royal Aircraft Establishment, Farnborough (England).
APPARATUS FOR PRESSURE WELDING OF TITANIUM STRUCTURES WITH A CONTROLLED RATE OF DEFORMATION
B. A. Matyushkin, E. M. Dzneladze, M. Kh. Shorshorov, A. S. Tikhonov, and V. V. Redchits Aug. 1987 7 p Transl. into ENGLISH from Svarochnoe Proizvodztvo (USSR), v. 26, no. 6, 1979 p 38-39
(RAE-Trans-2161) Avail: NTIS HC A02/MF A01

A technical description is given of equipment for pressure welding of Ti panel structures of 180 x 200 x 40 mm with preheating and automatic strain rate control. A pressure mechanism allows the welding to be carried out in the strain rate range from .00001 to .01/s. Results are presented of zero-to-tension low-cycle fatigue tests on butt welded joints of Ti alloy OT4 obtained on the equipment at the temperature 950 C, deformation 3 mm, and at various strain rates ranging from .00012 to .00096/s. A dependence of impact strength of the joints on strain rate from the range of .0001 to .001/s for welding temperature of 900, 920, and 950 C is also presented. Author

N88-25916*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SURFACE FATIGUE LIFE OF CBN AND VITREOUS GROUND CARBURIZED AND HARDENED AISI 9310 SPUR GEARS
Dennis P. Townsend and P. R. Patel (Textron Bell Helicopter, Fort Worth, Tex.) 1988 13 p Proposed for presentation at the International Off Highway and Powerplant Congress and Exposition, Milwaukee, Wis., 12-15 Sep. 1988; sponsored by the Society of Automotive Engineers Prepared in cooperation with Army Aviation Research and Development Command, Cleveland, Ohio
(DA Proj. 1L1-62209-A-47-A)
(NASA-TM-100960; E-4185; NAS 1.15:100960; AVSCOM-TR-88-C-019) Avail: NTIS HC A03/MF A01 CSCL 13I

Spur gear surface endurance tests were conducted to investigate CBN ground AISI 9310 spur gears for use in aircraft applications, to determine their endurance characteristics and to compare the results with the endurance of standard vitreous ground AISI 9310 spur gears. Tests were conducted with VIM-VAR AISI 9310 carburized and hardened gears that were finish ground with either CBN or vitreous grinding methods. Test conditions were an inlet oil temeprature of 320 K (116 F), an outlet oil temperature of 350 K (170 F), a maximum Hertz stress of 1.71 GPa (248 ksi), and a speed of 10,000 rpm. The CBN ground gears exhibited a surface fatigue life that was slightly better than the vitreous ground gears. The subsurface residual stress of the CBN ground gears was approximately the same as that for the standard vitreous ground gears for the CBN grinding method used. Author

N88-25917# Southwest Research Inst., San Antonio, Tex.
AN INVESTIGATION OF HIGH PRESSURE/LATE CYCLE INJECTION OF CNG (COMPRESSED NATURAL GAS) AS A FUEL FOR RAIL APPLICATIONS
J. F. Wakenell, G. G. ONeal, Q. A. Baker, and C. M. Urban Apr. 1988 148 p
(Contract DE-AC05-84OR-21400)
(DE88-009000; ORNL-Sub-85-22032/1) Avail: NTIS HC A07/MF A01

The use of natural gas in a medium-speed diesel engine is investigated. The effort was unique in the sense that natural gas was injected directly into the combustion chamber late in the compression stroke, as a high pressure gas rather than through low pressure fumigation or low pressure injection early in the compression stroke. Tests were performed on a laboratory two-cylinder, two-stroke cycle medium-speed diesel engine in an attempt to define its ability to operate on the high pressure/late cycle injection concept and to define the performance and emission characteristics of the engine under such operation. A small quantity of No.-2 diesel fuel was injected into the cylinder slightly before the gas injection to be used as an ignition source for the gas. Pilot (diesel fuel) and main (natural gas) timing and injection duration were systematically varied to optimize engine performance. The test demonstrated that the medium-speed engine was capable of attaining full rated speed and load (unlike the low pressure approach) with very low percentages of pilot injection with the absence of knock. Thermal efficiency was as much as 10 percent less than levels obtained with neat diesel fuel. This was due primarily to the placement and injection characteristics of the pilot and main injectors. Optimization of the injection system would undoubtedly result in increased thermal efficiency. DOE

N88-25918# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
ULTRASONIC AND VIDEO COMPUTERIZED DATA ACQUISITION FOR AUTOMATED WELDING
J. A. Johnson, N. M. Carlson, R. T. Allemeier, and D. G. Bannister 1988 10 p Presented at the Computer Technology in Welding, Cambridge, United Kingdom, 8 Jun. 1988
(Contract DE-AC07-76ID-01570)
(DE88-006741; EGG-M-25187; CONF-880686-1) Avail: NTIS HC A02/MF A01

A computerized data acquisition system has been developed and employed in sensing of gas metal arc welding (GMAW). Ultrasonic measurements of the weld-pool geometry have been made using expert-systems techniques to discriminate among the molten/solid interface geometries found during the root pass in a V-groove in carbon steel. A similar system was used to acquire video data from the Idaho National Engineering Laboratory (INEL) weld vision system and to measure the width of a weld pool as the welding parameters were systematically varied. The system is based on a CAMAC (Computer Automated Measurement and Control) crate controlled by an LSI 11/73 computer. The chief advantage of the CAMAC system is the ease of making both hardware and software changes. The CAMAC system provides a robust, well isolated interface for a large variety of data acquisition and control modules. In these applications transient digitizers collect the data (ultrasonic A scan or video line scan) under the control of the computer. The computer also collects information from timing and encoder modules in the CAMAC crate. Because the single software driver for the CAMAC system is the same for all modules, programming changes can be made in a higher level language (e.g., FORTRAN) rather than in assembler language. DOE

N88-25919# Oak Ridge National Lab., Tenn.
PULSATILE FLUIDIC PUMP PERFORMANCE AT ELEVATED TEMPERATURES
J. G. Morgan and W. D. Holland Jan. 1988 25 p
(Contract DE-AC05-84OR-21400)
(DE88-008046; ORNL/TM-10661) Avail: NTIS HC A03/MF A01

A series of tests was conducted to evaluate the performance of a pulsatile fluidic pump operating with simulated fuel solution at high temperatures. A computer program was written to model the performance of the system. Test results indicate little change in pump performance at temperatures up to the boiling point of the solution. The computer model predicted pumping system performance within 10 to 20 percent depending on the pump motivation pressure. DOE

N88-25920# Sandia National Labs., Albuquerque, N. Mex.
HYDROGEN TURBINES FOR SPACE POWER SYSTEMS: A SIMPLIFIED AXIAL FLOW GAS TURBINE MODEL
S. L. Hudson 1988 34 p Presented at the 5th Symposium on Space Nuclear Power Systems, Albuquerque, N. Mex., 11 Jan. 1988
(Contract DE-AC04-76DP-00789)
(DE88-009585; SAND-87-1923C; CONF-880122-12) Avail: NTIS HC A03/MF A01

This paper describes a relatively simple axial flow gas expansion turbine mass model, which we developed for use in our space power system studies. The model uses basic engineering principles and realistic physical properties, including gas conditions,

power level, and material stresses, to provide reasonable and consistent estimates of turbine mass and size. Turbine design modifications caused by boundary layer interactions, stress concentrations, stage leakage, or bending and thermal stresses are not accounted for. The program runs on an IBM PC, uses little computer time and has been incorporated into our system-level space power platform analysis computer codes. Parametric design studies of hydrogen turbines using this model are presented for both nickel superalloy and carbon/carbon composite turbines. The effects of speed, pressure ratio, and power level on hydrogen turbine mass are shown and compared to a baseline case 100-MWe, 10,000-rpm hydrogen turbine. Comparison with more detailed hydrogen turbine designs indicates that our simplified model provides mass estimates that are within 25 percent of the ones provided by more complex calculations. DOE

N88-25921*# Texas A&M Univ., College Station. Turbomachinery Lab.

ENTRANCE AND EXIT REGION FRICTION FACTOR MODELS FOR ANNULAR SEAL ANALYSIS Ph.D. Thesis

David Alan Elrod Aug. 1988 81 p

(Grant NAG3-181)

(NASA-CR-183084; NAS 1.26:183084; TL-SEAL-5-88) Avail: NTIS HC A05/MF A01 CSCL 13I

The Mach number definition and boundary conditions in Nelson's nominally-centered, annular gas seal analysis are revised. A method is described for determining the wall shear stress characteristics of an annular gas seal experimentally. Two friction factor models are developed for annular seal analysis; one model is based on flat-plate flow theory; the other uses empirical entrance and exit region friction factors. The friction factor predictions of the models are compared to experimental results. Each friction model is used in an annular gas seal analysis. The seal characteristics predicted by the two seal analyses are compared to experimental results and to the predictions of Nelson's analysis. The comparisons are for smooth-rotor seals with smooth and honeycomb stators. The comparisons show that the analysis which uses empirical entrance and exit region shear stress models predicts the static and stability characteristics of annular gas seals better than the other analyses. The analyses predict direct stiffness poorly. Author

N88-25922*# National Aeronautics and Space Administration, Washington, D.C.

INVESTIGATION OF ROLLING CONTACT FATIGUE OF BALL BEARINGS

Norimune Soda Jul. 1988 218 p Transl. into ENGLISH of Japan Society for the Promotion of Science, Research Committee (Japan), no. 126, 1987 p 1-155 Transl. by SCITRAN, Inc., Santa Barbara, Calif.

(Contract NASw-4307)

(NASA-TT-20196; NAS 1.77:20196) Avail: NTIS HC A10/MF A01 CSCL 13I

Tests were carried out using solid lubricants of two types with molybdenum disulphide additive, and another single type with graphite additive. The following results were obtained: (1) Solid lubricant has a tendency to decrease bearing life 50 to 70 percent. This tendency becomes striking when the particle size is large, as with molybdenum disulfide. Also graphite has a shortening effect in the first stage of operation but this disappears as opertaion time increases; (2) The influence of solid lubricant on bearing life is mainly to decrease outer ring life; and (3) Even in grease with solid lubricant added, there is a bearing life of twice that with oil lubrication. Author

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N88-25923*# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.

ACOUSTO-ULTRASONIC INPUT-OUTPUT CHARACTERIZATION OF UNIDIRECTIONAL FIBER COMPOSITE PLATE BY P WAVES Final Report

Peter Liao and James H. Williams, Jr. Jul. 1988 78 p

(Grant NAG3-328)

(NASA-CR-4162; E-4208; NAS 1.26:4162) Avail: NTIS HC A05/MF A01 CSCL 14D

The single reflection problem for an incident P wave at a stress free plane boundary in a semi-infinite transversely isotropic medium whose isotropic plane is parallel to the plane boundary is analyzed. It is found that an obliquely incident P wave results in a reflected P wave and a reflected SV wave. The delay time for propagation between the transmitting and the receiving transducers is computed as if the P waves were propagating in an infinite half space. The displacements associated with the P waves in the plate and which may be detected by a noncontact NDE receiving transducer are approximated by an asymptotic solution for an infinite transversely isotropic medium subjected to a harmonic point load. Author

N88-25924*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.

SEMI-MARKOV ADJUNCTION TO THE COMPUTER-AIDED MARKOV EVALUATOR (CAME)

Gene Rosch, Monica A. Hutchins, Frank J. Leong, and Philip S. Babcock, IV Apr. 1988 69 p

(Contract NAS9-17560)

(NASA-CR-181645; NAS 1.26:181645) Avail: NTIS HC A04/MF A01 CSCL 14D

The rule-based Computer-Aided Markov Evaluator (CAME) program was expanded in its ability to incorporate the effect of fault-handling processes into the construction of a reliability model. The fault-handling processes are modeled as semi-Markov events and CAME constructs and appropriate semi-Markov model. To solve the model, the program outputs it in a form which can be directly solved with the Semi-Markov Unreliability Range Evaluator (SURE) program. As a means of evaluating the alterations made to the CAME program, the program is used to model the reliability of portions of the Integrated Airframe/Propulsion Control System Architecture (IAPSA 2) reference configuration. The reliability predictions are compared with a previous analysis. The results bear out the feasibility of utilizing CAME to generate appropriate semi-Markov models to model fault-handling processes. Author

N88-25925 Selskapet for Industriell og Teknisk Forskning, Trondheim (Norway).

FAILURE RATE PREDICTION OF ELECTRONIC COMPONENTS

L. Bodsberg 10 Mar. 1987 39 p Sponsored by Royal Norwegian Council for Scientific and Industrial Research, Oslo

(PB87-228953; STF75-A87006; ISBN-82-595-4761-9) Avail: NTIS HC E04/MF E04; copy not available from STI Facility CSCL 14D

Data on the correlation between predicted and observed failure rates for electronic parts (components), equipment and systems is presented. MIL-HDBK-217 failure rate prediction procedures are discussed and compared with the procedures developed by companies which do not exclusively manufacture according to supervised U.S.-MIL specifications. It is shown that the MIL-HDBK-217 failure rate data is too pessimistic for commercial devices if the procedures are followed exactly. Thus, guidelines are given regarding the use of MIL-HDBK-217 for devices which are not processed and screened in accordance to U.S.-MIL specifications. Author

N88-25926# Lawrence Livermore National Lab., Calif.
MODEL-BASED COMPUTED TOMOGRAPHY FOR NONDESTRUCTIVE EVALUATION: AN OVERVIEW AND PROPOSAL Ph.D. Thesis - California Univ.
Stephen G. Azevedo 16 Jan. 1988 74 p
(Contract W-7405-eng-48)
(DE88-010600; UCID-21380) Avail: NTIS HC A04/MF A01

A research plan for computationally solving the hollow projections problem in computed tomography (CT) imaging of industrial objects is proposed. The algorithms studied are those best suited for nondestructive evaluation (NDE) of industrial objects where applicable mathematical models are available and where the objective is to improve the diagnostic image quality. The hollow projections problem occurs when the relative X-ray attenuations of various regions in the inspected object are vastly different. Some of the projected X-rays are completely attenuated (no photons are received) thereby reducing the information in the measured signals. In this case, conventional reconstruction algorithms produce artifacts in the reconstructed image. Background material about the current capabilities and limitations of CT systems makes up the bulk of this paper. Various design parameters for a generic CT scanner are described in terms of both the data acquisition and the image reconstruction phases. In particular, those specifications which distinguish NDE inspections from medical imaging are outlined. The mathematics of CT, the Radon transform and its various inverses, with discretization effects is reviewed briefly. The current algorithmic techniques based on those mathematics are summarized. More recent algorithms described in the literature for operating on limited and noisy data are given special consideration. Some of these methods present novel ways of using a priori information in the reconstruction process. A detailed proposal of the research effort planned for the next few years concludes the report. DOE

N88-25927# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
DETERMINING SYSTEM MAINTAINABILITY AS A PROBABILITY
R. E. Wright and C. L. Atwood 1988 5 p Presented at the 15th INTER-RAM Conference for the Electric Power Industry, Portland, Oreg., 14 Jun. 1988
(Contract DE-AC07-76ID-01570)
(DE88-007722; EGG-M-40887; CONF-880692-2) Avail: NTIS HC A02/MF A01

Maintainability has often been defined in principle as the probability that a system or component can be repaired in a specific time given that it is in a failed state, but presented in practice in terms of mean-time-to-repair. In this paper, formulas are developed for maintainability as a probability, analogous to those for reliability and availability. This formulation is expressed in terms of cut sets, and leads to a natural definition of unmaintainability importance for cut sets and basic events. DOE

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N88-25928*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PREDICTED AND MEASURED STRAIN RESPONSES OF ISOTROPIC PANELS TO BASE EXCITATION
Karen H. Lyle, Jack D. Leatherwood, and Edward F. Daniels Aug. 1988 11 p Sponsored by NASA, Washington
(DA Proj. 1L1-61102-AH-45C)
(NASA-TM-4054; L-16446; NAS 1.15:4054; AVSCOM-TM-88-B-013) Avail: NTIS HC A03/MF A01 CSCL 20K

The accuracy of classical linear theory for predicting acceleration and strain for cantilevered and Clamped-Free-Clamped-Free (C-F-C-F) panels excited through the base is studied. Aluminum, steel and titanium plates of various dimensions and thicknesses were vibration tested, using a broadband random signal applied through a shaker mounting fixture. The strains were measured at 9 locations on the cantilevered panels and at 5 locations on the C-F-C-F panels. Predictions were based on the Ritz method. The measured accelerations of the base were input to the analysis for the forcing function. Comparisons between predicted and measured strain acceleration spectra were within an average error of 20 percent for both the cantilevered and C-F-C-F panels. Author

N88-25929# Rhode Island Univ., Kingston. Dept. of Mechanical Engineering and Applied Mechanics.
STUDY OF PROBABILISTIC FATIGUE CRACK GROWTH AND ASSOCIATED SCATTER UNDER CONSTANT-AND-VARIABLE AMPLITUDE LOADING SPECTRUM Annual Report, 15 Jul. 1986 - 15 Jul. 1987
Hamouda Ghonem 6 Sep. 1987 60 p
(Grant AF AFOSR-0362-85)
(AD-A192027; AFOSR-88-0216TR) Avail: NTIS HC A04/MF A01 CSCL 11F

The objective of the program's second year research work was to examine the validity of the constant probability crack growth model while refining the transition intensity parameter. This work has been completed, thus leading to a crack growth rate equation with an explicit probability term. Furthermore, work extending the applicability of the model to variable loading required the determination of the delay-time associated with a single overload. An experimental test program was carried out on a titanium alloy using a potential drop technique to record crack length increments as functions of overload characteristics. This program has been completed and results will be incorporated into the basic stochastic model. GRA

N88-25930 New South Wales Univ., Kensington (Australia). Dept. of Structural Engineering.
A SIMPLE UNIFIED METHOD FOR PREDICTING THE DEFLECTIONS OF REINFORCED CONCRETE STRUCTURES Abstract Only. M.S. Thesis
Young Sik Shin Apr. 1987 70 p
Avail: Issuing Activity

A simple unified method is presented to predict the deflections due to bending deformations of ordinary reinforced as well as fully or partially prestressed concrete structures subjected to sustained loading. It takes into consideration the nonlinear effects of cracking, and tension stiffening, and the time-dependent effects of creep and shrinkage. To account for the variation in moment of inertia of flexural members, a beam finite element model with parabolically varying moment of inertia along its length, was developed for use in the conventional stiffness analysis of structures. The effective bending stiffness at any section of any one element is evaluated using the well-known expression suggested by Branson. The effects of creep and shrinkage are treated in a similar manner to member distortions due to initial conditions in conventional elastic analysis. The applicability of the proposed method was demonstrated by the analysis of several concrete structures in which measured values of deflections, and in some cases measured values of internal forces, are available. Comparison between predicted and measured values for instantaneous and long-term deflections may be considered to range from satisfactory to excellent. The proposed method is simple, easy to follow and leads to a compact and computationally economical formulation. It can be conveniently implemented in programmable calculators or micro-computers, and can easily be integrated into existing stiffness analysis programs. Author

N88-25931 New South Wales Univ., Kensington (Australia). Dept. of Civil Engineering.
STATIC ANALYSIS OF THIN PLATES USING THE FINITE STRIP-ELEMENT METHOD M.S. Thesis. Abstract Only

William Alfred Grice Oct. 1987 130 p
Avail: Issuing Activity

Finite strip-elements for thin plate bending and two families of finite strip-elements for thin plate plane stress analysis are developed. All strip-elements presented exhibit partial uncoupling of global stiffness equations which is computationally efficient. Special procedures requiring minimum computer core are presented as well as general procedures for the analysis of structures with any boundary conditions, including mixed boundary conditions. The general procedures require additional nodal variables but still exhibit partial uncoupling of global stiffness equations. Free edge boundary conditions are approximately treated as natural boundary conditions while clamped boundary conditions are exactly satisfied by modifying global stiffness equations using Lagrange multipliers. Finite strip-elements for the analysis of prismatic folded plate structures with any boundary conditions, including mixed boundary conditions, are formed by combining plate bending strip-elements with a compatible family of plane stress strip-elements. Numerical examples demonstrate the accuracy and efficiency of the methods. Convergence can be assessed, without increasing computer core requirements, by increasing the number of trigonometric terms in displacement functions. Author

N88-25932 Kentucky Univ., Lexington.
STABILITY OF DYNAMICAL SYSTEMS SUPPORTED BY RUBBER SPRINGS Ph.D. Thesis
Ranjan Bhattacharyya 1987 253 p
Avail: Univ. Microfilms Order No. DA8802573

Problems on the stability of three dynamical systems sypported by rubber mountings are studied. The first problem deals with the stability of motion of a rigid block supported by simple shear springs fastened to an inclined circular plate rotating at a constant angular speed about an axis. The governing nonlinear equation of motion of the block resulting from the simple shear deformation of the springs is found to resemble the forced Duffing equation. Stability of the relative equilibrium solutions and of certain special cases of this equation is investigated. Stability maps and, in some cases, bifurcation diagrams are obtained. In the second problem, the stability of small torsional oscillations coupled with large axial vibrations of a heavy disk attached rigidly at one end of an inlcined neo-Hookean rubber spring support is investigated. A closed form periodic solution for the axial response is obtained. The effect of variable gravity force is also discussed. The third problem is an extension of the second where two different rubber springs are attached on opposite faces of the heavy disk. The equations for the torsional and axial motions of the disk are obtained for the horizontal spring-disk configuration, and three special cases of motion are considered for both identical and nonidentical rubber springs. Stability of the equilibrium solutions are discussed. Comparison of this result with the corresponding case in the second problem described earlier, shows that the addition of the symmetric identical spring has a stabilizing effect on its motion.
Dissert. Abstr.

N88-25933 Stanford Univ., Calif.
TRANSIENT ANALYSIS OF A PLATE ON AN ELASTIC FOUNDATION UNDER A MOVING LOAD Ph.D. Thesis
Hsi-Ming Pan 1987 106 p
Avail: Univ. Microfilms Order No. DA8801004

The condition of equally spaced moving loads on a plate strip is analogous to that of a stationary load on a spinning disk. An infinite train of equally spaced concentrated loads moves at constant speed in the longitudinal direction of the plate strip. The loads could also move laterally, causing transients to the plate strip like those caused in the specific case of the computer disk by radial movement of the transverse load due to the read/write head. This analogy between plate strip and spinning disk serves as a basis for study of the dynamic response of an infinite plate strip on an elastic foundation with moving loads. The two edges of the plate strip are assumed to be simply supported. Fourier series in the lateral coordinate and in time are used to obtain exact solutions for the basis of the computation. The characteristic equation of this problem contains information about critical curves in the frequency speed domain which helps to determine the resonance free regions. Steady sinusoidal lateral movements of the loads excite the strip at harmonics, reducing the resonance free range. Transients caused by lateral movements of the loads are calculated by using steady state solutions and Fast Fourier Transform. Dissert. Abstr.

N88-25934# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
PREDICTION OF FATIGUE LIFE OF NOTCHED SPECIMENS UNDER AIRCRAFT LOADING AND IMPORTANCE OF THE RELATIVE METHOD IN THE CASE OF LOCAL STRAIN APPROACH, PART 2
A. Buch and A. Berkovits May 1987 42 p Sponsored in part by the SENIEL OSTROV research fund and the TECHNION VPR fund
(TAE-595-Pt-2) Avail: NTIS HC A03/MF A01

The aim of the research was to compare life predictions obtained from block-by-block counting using a versatile computer program (LSA2) with those obtained in cycle-by-cycle counting from another program. For better understanding of the effect of memory rules on the predictive accuracy, the comparison of the prediction with experiment covered both LSA versions for both corrected and uncorrected cases. The life predictions are dependent on the value of K used in Neuber's relation. Therefore, the calculations were sometimes performed in parallel using both K=K sub T and K=K sub F. Results of maneuver loading spectra for both Ti and Al alloy aircraft materials are considered. Prediction of the effect of stress concentration and material variation is verified for LSA predictions. Application of the relative method for fully randomized loading spectra is extended to a variety of steels and K sub T values. J.P.B.

N88-25935*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IMPROVED METHOD FOR STRESS AND COMPATIBILITY ANALYSIS OF MULTICOMPONENT ROTATING SYSTEMS
Gerald A. Carek Jun. 1988 31 p
(NASA-TM-100884; E-4117; NAS 1.15:100884) Avail: NTIS HC A03/MF A01 CSCL 20K

An improved method of analyzing multicomponent rotating assemblies for the determination of operating stresses and component compatibility has been developed. In this method, a single finite element model is developed which contains all of the separate components in the rotating assembly. This is made possible by using gap elements to simulate the contact surfaces between components. The MARC finite element computer program is then used to perform the analysis. This improved method is less time consuming and more reliable than the conventional method of analyzing such systems. Results are presented for two different stress-compatibility analyses of a six-component axial flow compressor rotor. The results for the previously used flexibility analysis method are compared with those for the improved analysis method. The stresses predicted by each method compare quite well with each other. The predictions of the component compatibility, as well as the magnitude of the forces at the contact surfaces, also compare well for these two analysis procedures. It is therefore recommended that the improved analysis method be used to determine the stress-compatibility characterstics of multicomponent rotating systems. Author

N88-25936# Los Alamos National Lab., N. Mex.
MATERIAL VOID OPENING COMPUTATION USING PARTICLE METHOD
W. H. Lee and J. W. Painter 1988 15 p Presented at the International Conference on Computational Physics, Beijing, China, 4 Jun. 1988
(Contract W-7405-eng-36)
(DE88-010950; LA-UR-88-1691; CONF-880638-1; CONF-880638)
Avail: NTIS HC A03/MF A01

When performing the calculation of material flow in two dimensional Eulerian coordinates, one always encounters the difficulties of modeling the void opening due to material failure

such as fracture, spallation, or phase change. The present studies use one type of particle to represent the material and another type for the void space. According to the flow conditions, the void space may grow with crack propagation or may be recombined with the void space closed up when the volume decreases. The penetration of a copper rod into, and eventually through a steel plate, is calculated using the present code. DOE

N88-25937*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CHARACTERIZATION OF FATIGUE CRACK INITIATION AND PROPAGATION IN TI-6AI-4V WITH ELECTRICAL POTENTIAL DROP TECHNIQUE
Sreeramesh Kalluri and Jack Telesman Jul. 1988 25 p Prepared in cooperation with Sverdrup Technology, Inc., Cleveland, Ohio (NASA-TM-100877; E-4111; NAS 1.15:100877) Avail: NTIS HC A03/MF A01 CSCL 20K

Electrical potential methods have been used in the past primarily to monitor crack length in long crack specimens subjected to fatigue loading. An attempt was made to develop test procedures for monitoring the fatigue crack initiation and the growth of short fatigue cracks in a turbine disk alloy with the electrical potential drop technique (EPDT). In addition, the EPDT was also applied to monitor the fatigue crack growth in long crack specimens of the same alloy. The resolution of the EPDT for different specimen geometries was determined. Factors influencing the EPDT are identified and the applicability of EPDT in implementing damage tolerant design concepts for turbine disk materials is discussed. The experimental procedure adopted and the results obtained is discussed. No substantial differences were observed between the fatigue crack growth data of short and long crack specimens. Author

N88-25625# Joint Publications Research Service, Arlington, Va.
RESEARCH ON FRACTOGRAPHY OF HEAT-RESISTANT ALLOYS
H. Terada *In its* JPRS Report: Science and Technology. Japan 4 May 1988 p 54-55 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jan. 1988 p 6-8 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

N88-26050# Institut Francais de Recherche pour l'Exploitation de la Mer, Brest (France). Dept. Qualite Essais.
MATERIALS QUALIFICATION IN OCEANOLOGY AND THE OFFSHORE INDUSTRY [QUALIFICATION DES MATERIELS EN OCEANOLOGIE ET INDUSTRIE OFFSHORE]
Jean-Francois Couchouron *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 247-250 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

42 GEOSCIENCES (GENERAL)

N88-25938# National Academy of Sciences - National Research Council, Washington, D. C.
US PARTICIPATION IN THE TOGA (TROPICAL OCEAN AND THE GLOBAL ATMOSPHERE) PROGRAM: A RESEARCH STRATEGY
1988 31 p
(Contract DE-AI01-79EV-10215)
(DE88-010986; DOE/EV-10215/T2) Avail: NTIS HC A03/MF A01

The past 20 years have been some major advances in understanding the time-dependent behavior of the coupled atmosphere-ocean climate system. This document describes a new international program devoted to extending this knowledge and modeling capability and applying them to the problem of monthly and seasonal climate prediction. The program is known by the acronym TOGA, which stands for the (Interannual Variability of the) Tropical Ocean and the Global Atmosphere. The objectives of the TOGA program are: to determine to what extent the time-dependent behavior of the tropical oceans and related planetary scale circulation patterns are predictable on time scales ranging from weeks to a few years and to understand the mechanisms that give rise to this predictability; and to explore the potential of coupled atmosphere-ocean system models for predicting climatic variability on these time scales and, within the context of that predictive capability, to develop an observing and data management system to support operational climate prediction. DOE

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N88-25939# Instituto de Pesquisas Espaciais, Campos do Jordao (Brazil).
NATIONAL MEETING ON REMOTE SENSING APPLIED TO MUNICIPAL PLANNING [ENCONTRO NACIONAL DE SENSORIAMENTO REMOTO APLICADO AO PLANEJAMENTO MUNICIPAL]
1987 301 p In PORTUGESE Meeting held in Campos do Jordao, Brazil, 22-23 Oct. 1987 Prepared in cooperation with Sociedad de Especialistas Latinoamericanos en Percepcion Remota, Chile Sponsored by Prefeitura Municipal da Estancia de Campos do Jordao and Secretaria da Cultura do Estado de Sao Paulo
Avail: NTIS HC A14/MF A01

Topics addressed include: land use mapping; remote sensing applications; satellite imagery of agriculture activity; impact of occupation in urban areas; photointerpretation; production of hemp; municipal planning; computer graphics; and aerial photography. For individual titles, see N88-25940 through N88-25958.

N88-25940# Instituto de Pesquisas Espaciais, Campos do Jordao (Brazil).
MAPPING OF LAND USE IN SAO JOSE DOS CAMPOS MUNICIPALITY BY REMOTE SENSING, AN AID FOR THE ELABORATION OF ITS PDDI [MAPEAMENTO DO USO DA TERRA DO MUNICIPIO DE SAO JOSE DOS CAMPOS POR SENSORIAMENTO REMOTO, COMO SUBSIDIO PARA A ELABORACAO DO SEU PDDI]
Madalena NieroPereira, Maria deLourdesNevesdeOliveiraKurkdjian, and Bernardo deOliveiraSampaio *In its* National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 1-19 In PORTUGESE (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

This work seeks to show the use of remote sensing data for the realization of land use inventories, with the view to the elaboration of the Administrative Plans for Integrated Municipal Development (PDDI). Based on results obtained from the project, Updating of land use in the Sao Jose dos Campos municipality through remote sensing data - AUTES, relevant information was identified as the diagnostic realization of municipal territorial organization, obtained through orbital imagery, which is utilized as an aid for the elaboration of the PDDI. Author

N88-25941# Instituto de Pesquisas Espaciais, Campos do Jordao (Brazil).
REMOTE SENSING TECHNIQUES APPLIED TO THE STUDY OF METROPOLITAN REGIONS: THE WEST SECTOR OF THE SAO PAULO METROPOLITAN AREA [TECNICAS DE SENSORIAMENTO REMOTO APLICADAS AO ESTUDO DE REGIOES METROPOLITANAS: O SETOR OESTE DA AREA METROPOLITANA DE SAO PAULO]
Celina Foresti *In its* National Meeting on Remote Sensing

Applied to Municipal Planning 1987 p 20-31 In PORTUGESE (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

The remote sensors on board new satellites are more and more adequate for urban study, in increasing the functional capability of spatial, spectral, and radiometric resolution. This work presents a methodological focus for the study of expansion and structurization of urban space in metropolitan areas through orbital remote sensing data in different levels and scales of observation. Data from LANDSAT MSS and TM and digital panchromatic HRV data from the SPOT satellite are utilized. The experimental area corresponds to the western sector of the Sao Paulo metropolitan area, constituting an urbanized area or municipalities in the process of urbanization in Osasco, Carapicuiba, Barveri, Itapei, Jandira, and Santana do Parnaiba. The results of the work show urban expansion occurring with the opening of new land plots which are constantly deep-rooted, of adequate form, and adapted to ground conditions. Measurement is aggravated by this problem, which is most unevenly raised, presenting the major indices of declivity. This work discusses the current atmospheric problems in the use and disorganized ground occupancy, also the nonexistence of planning and integrated administration for composition of the metropolitan regions of Brazil. Author

N88-25942# Sensoriamento Remoto dos Recursos Naturais, Rio de Janeiro (Brazil).
TERRITORIAL MANAGEMENT PROGRAM
Luiz Henrique AzevedoelaraMusseFelix *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 32-48 (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

The Territorial Management consists of a first element, a survey of information from the territory, adequate space planning in its vocation and natural potentiality assignment considered through physical-spatial diagnostics. The next stage, second element, represents the design implantation, where the interaction of the modules orient the process, Diagnostic Planning, was systematically reviewed. Author

N88-25943# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
TECHNIQUE TO OBTAIN THE AGRICULTURAL OWNERSHIP LIMITS BY SATELLITE IMAGERY, TO APPROVE CONTROL, AND TO ACCOMPANY AGRICULTURAL ACTIVITY [TECNICA PARA OBTER LIMITES DE PROPRIEDADES AGRICOLAS SOBRE IMAGENS DE SATELITE, VISANDO CONTROLAR E ACOMPANHAR A ATIVIDADE AGRICOLA]
Valdete Duarte *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 49-57 In PORTUGESE (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

The contents are an integral part of the comprehensive project designated FISATE (supervision of agricultural ownership by satellite), routinely conducted through INPE by a pact with the Bank of Brazil, S.A., through its Incentive Fund for Technical-Scientific Research (FIPEC). This opportunity is evidence of the stage of cadastral agricultural ownership by aerial photographic registry and transposition to satellite imagery in 1:100,000 scale. This methodology certifies control and unites the agricultural activity through satellite imagery. Making use of this establishes the following: aerial photographs of records in the 1:35,000 scale; photoindex in the 1:100,000 scale; and IBGE topographical maps in the 1:250,000 and 1:50,000 scales. An officer of the Bank of Brazil, bound to the banking agency of the Assis municipality (SP), receives training with the purpose of becoming capable in the handling of aerial photographs and to qualify for executing assignments concerning the collection of information for obtaining the assessed lands of agricultural ownership. Once demarcated, the limits of agricultural ownerships which receive financing for planting are transferred from the cartographic basis, 1:50,000 scale, over the aerial photographs, through the KARTOFLEX equipment. This draft is reduced photographically to a 1:100,000 scale, compatible with the satellite imagery. The final product is a transparency containing the agricultural ownership of the bank customers. The farming interests of the bank are verified and united through satellite imagery. Author

N88-25944# Fundacao de Ciencia, Aplicacoes e Technologia Espaciais, Sao Jose dos Campos (Brazil).
THE USE OF SATELLITE IMAGERY FOR MUNICIPAL CONDITIONS IN RURAL RECORDING IN PEREIRA BARRETO (SP)
Kleber deFaria, Cassia B. S. Veiga, Marcia Morgado, Renato dosSantos, Marcos Covre, Ricardo L. V. Rodrigues, Francisco Jose Mendonca (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil), and Flavio Gewandsnajder *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 58-68 (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

To be considered for the requirement of area selection for rural registration for the short term, capable ways and means should be utilized to perform the whole process which involves an expropriation. The primary stage of this process is the selection of areas which present a low degree of utilization. This mapping by satellite imagery, was shown as an instrument useful for information collection of natural resources destined for agriculture. This work analyzes the soil use, basically through the vegetal cover existing in the Pereira Barreto municipality, located north of the Sao Paulo State. The objective was to quantify areas with a low degree of utilization of municipal conditions of ownership. The TM/LANDSAT imagery is utilized in black and white documents, channels 3 to 4, scale 1:100,000 with data from the 12 November 1985 to 24 June 1986 passage. Through visual analysis the imagery was separated into three classes: clean fields; dirty field of bushveld; and woodsy/pasture. The dirty fields of bushveld are considered as areas of potential expropriation. Therefore, the results encountered concerning this subject are 28 percent of the municipal territory and for the conditions of ownership that were studied: Fazenda Conquista, totally utilized; Fazenda Maria Ofelia, 42 percent; Fazenda Sao Joaquim, 48 percent; Fazenda Santa Terezinha, 56 percent; Fazenda Esmeralda, 67 percent; Fazenda Sao Rafael, 78 percent; and Fazenda Sao Lutz, 100 percent. Author

N88-25945# Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
THE IMPACT OF DISORGANIZED OCCUPATION OF URBAN SUB-BASINS: SUB-BASIN OF THE CABUCU RIVER, METROPOLITAN AREA OF SAO PAULO (SP)
Sergio Luis Pompeia and Celina Foresti (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil) *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 69-79 (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

Color composites of satellite multispectral remote sensing data were used in order to study the evolution of urban spread and consequent results in the basin of the Cabucu de Cima River of the metropolitan area of Sao Paulo. The results refer to MSS-LANDSAT data obtained in June 26, 1976, and by TM-LANDSAT data from June 16, 1985. These scenes were magnified by the Interative Multispectral Image Analyzer System (IMAGE-100) to the scale of 1:50,000. Three classes of color and texture patterns were established according to the ground occupation level. The final results were plotted at the scale of 1:25,000. Selected patterns and their geographic limits were field checked in order to allign the confection of maps of the basin ground occupation for 1976 and in 1986 scenes, indicating areas exposed to inundation hazards. Author

N88-25946# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
PHOTOINTERPRETATION WITH INSTRUMENTATION FOR EVALUATION OF ENVIRONMENTAL IMPACT: MATA ATLANTICA IN CUBATAO [A FOTOINTERPRETACAO COMO INSTRUMENTO PARA AVALIACAO DE IMPACTO AMBIENTAL: A MATA ATLANTICA EM CUBATAO]
Dalton deMorissonValeriano and Flavio Jorge Ponzoni *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 80-96 In PORTUGESE (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

In order to study the impact of the atmospheric pollution originating from the Cubatao industrial plants over the Mata Atlantica (a strip of tropical rain forest formation that stretches along the Brazilian eastern coast) on the slopes of the Serra do Mar (a mountain chain that runs parallel to the southeastern coast), color infrared air photography (1:25,000) was used to map the vegetation cover and the land use of approximately 240 sq km, covering degraded areas (Mogi River valley) and preserved areas (Quilombo River valley). The photographic analysis found that the degradation of the vegetation structure by the air pollution is done by the selective and progressive elimination of the largest elements, which may, in its most intensive level, reduce the forest into a shrubbery. Considering that the Mata Atlantica slowly builds its capacity to preserve slope stability, a long period in which the risk of a natural disaster by means of landslides is foreseen as a great threat to the region in the rainy season. Author

N88-25947# Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
STUDY OF EVOLUTION OF VEGETAL COVER AND SLIDE SCARS IN THE CUBATAO MUNICIPALITY-SAO PAULO
Celina Franco Braganca, Elisabete Cristina Kono, Luiza Saito JunqueiraAguiar, and Roney PerezdosSantos *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 97-113 (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

Atmospheric pollution liberated by the industrial complex of Cubatao acting on the vegetation of the Mogi River valley, in the Serra do Mar, promotes a reduction in the number of higher stratum plants and the decreasing of biomass exposing the Serra do Mar acclivity to the risks of sliding. The objective considers the obtained space-time diagnostics of the occurring degradation in the Cubatao region, which accelerates the function of the erosive processes, with emphasis on slipping. The expansion of soil use is also accompanied by urban and industrial activities. This diagnostic use, basically, aerial photointerpretation, is the most adequate and possible technique for this evaluation. The systematic field work was done just for the 1985 survey. Author

N88-25948# Fundacao de Ciencia, Aplicacoes e Technologia Espaciais, Sao Jose dos Campos (Brazil).
THE IMPACT OF HEMP PRODUCTION ON THE DEVELOPMENT OF THE MUNICIPALITIES OF ARARAS, LEME, SANTA CRUZ DA CONCEICAO AND PIRASSUNUNGA
Marcos Covre, Cassia B. S. Veiga, Marcia Morgado, Renato dosSantos, Ricardo L. V. Rodrigues, Kleber deFaria, Francisco Jose Mendonca (Instituto de Pesquisas Espaciais, Sao Jose dos Campos, Brazil), and Flavio Gewandsznajder *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 114-130 (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

Data from LANDSAT-5 and SPOT-1 satellites were utilized to update soil use in 4 municipalities of Sao Paulo (Araras, Leme, Santa Cruz da Conceicao, and Pirassununga) which were posteriorly compared, the mapping performed in 1978 was studied for the dynamics of land use, with the emphasis on the expansion of hemp cultivation. Also, information on use capacity as well as environmental parameters of the hydrographic network are evaluated. The work shows a large expansion of hemp cultivation in the four municipalities, on the average a 45 percent increase; alternating the use of the land and interferring in environmental equilibrium. The utilization of orbital data in regional analyses was useful in showing the perspectives of remote sensing techniques in these studies. Author

N88-25949# Instituto Florestal, Sao Paulo (Brazil).
APPLICATION OF REMOTE SENSING IN THE CONSERVATION OF NATURAL AREAS: RIBEIRA VALLEY [APLICACAO DO SENSORIAMENTO REMOTO NA CONSERVACAO DE AREAS NATURAIS - VALE DO RIBEIRA]
Hideyo Aoki *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 131-143 In PORTUGESE (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

This is a description of studies carried out in the Parque Estadual de Jacupiranga, spreading over Barra do Turvo, Cananeia, Eldorado, Paulista, Iporanga, and Jacupiranga counties, utilizing LANDSAT imagery and aerial photographs. The studies permitted subsides on the biophysical environment characteristics and the establishment of guiding and/or the decisions to be made by the county and/or state governments, to assure the compliment of legal measures of protection and to avoid the irreversible degradation of one of the more fragile and important ecosystems of the Brazilian territory. Author

N88-25950# Universidade Estudual de Paulista, Rio Claro (Brazil).
USE OF REMOTE SENSING IN THE STUDY OF SUPERFICIAL FORMATION CERTIFYING THE DEVELOPMENT OF INTEGRATED ECONOMY-CASE EXAMPLE: RIO CLARO (SP) REGION
Paulina SettiRiedel, Juercio TavaresdeMattos, and Jairo Roberto JimenezRueda *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 144-150 (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

The present work proposes a methodology for systematic interpretation of remote sensing data for the mapping of superficial formation of the Rio Claro (SP) region, as an aid, in the organization of physical resources. The method utilized includes the analysis of textural elements of raised structures, and drainage certifying the shape characteristics of these properties. Author

N88-25951# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
REMOTE SENSING TECHNIQUE APPLIED TO VEGETATION AS AN AID TO MUNICIPAL PLANNING [O SENSORIAMENTO REMOTO APLICADO A VEGETACAO COMO SUBSIDIO AO PLANEJAMENTO MUNICIPAL]
Dalton deMorissonValeriano, Joao Roberto dosSantos, Pedro HernandezFilho, and Vitor CelsodeCarvalho *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 151-164 In PORTUGESE (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

The rational exploration of the natural resources of a municipality must be one of the objectives of its administration. New technologies offer means and alternatives that make possible the full utilization of the natural resources within the limits of the carrying capacity of the environment. Remote sensing of the vegetation is one of these available means. The assessment of the vegetation cover through mapping and inventories provides basic informations for the establishment of policies and strategies for the development. The monitoring of the vegetation, which is made through periodic updating of its assessment, allows the evaluation of the results of the policies, besides the fact that it depicts trends in the pattern of resources exploration. The applicability of the remote sensing of the vegetation to the municipal planning through the analysis of its foundations and methodological pecularities are discussed. Case studies of the Brazilian vegetation are presented in order to picture the state of the are of the subject in Brazil. Author

N88-25952# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
UPDATING OF MUNICIPAL OFFICIAL REGISTER OF REAL ESTATE THROUGH THE GEOGRAPHICAL INFORMATION SYSTEM [ATUALIZACAO DO CADASTRO IMOBILIARIO MUNICIPAL ATRAVES DE UM SISTEMA DE INFORMACOES GEOGRAFICAS]
Adriana Abrahao and Moacir Godoy, Jr. *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 165-179 In PORTUGESE (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

The objective is to demonstrate the viability of automatization of municipal official register of real estate using the geographical information system now in development at INPE. The test area was Jambeiro City located in the Vale do Paraiba region, Sao Paulo state. All the pilot system to update the maps and the legal taxes was developed considering these official register data.
Author

N88-25953# Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
APPLICATION OF 35mm EM AERIAL RECONNAISSANCE PHOTOGRAPHIC FORMAT OF THE MUNICIPALITY OF UBATUBA (SP)
Joao Roberto Rodrigues *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 180-199 (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

The obtained results and the application possibilities of the photos surpasses the initial expectation of the equipment. This fact points out the necessity of greater detailing in pre-flight planning, to attain the pattern by completing the other possible objectives with a technique utilized and not anticipated in this primary work. On the other hand, the simplicity of the process and cost decrease relative to coverage, indicates a great potential for utilization of this type of monitoring for Municipality City Hall and other entities in small and medium communities of the region, utilizing professional photographs at the proper cities in addition to single engine aircraft of airclubs or rural ownership, having the necessary restrictions to fly without carrying the aircraft remote wing type. It was confirmed that small degree stereoscopic images could be obtained through the mounting of 2 cameras on a support, adequately distanced and endowed drivers with sole command for simultaneous precise discharge. Finally it can be concluded that the production of aerial recognition photography with a 35 mm format fill an important gap in existing sensor resources, in view of the inaccessibility of this most sophisticated technique, has a large number of uses; principally, owing to the limitations imposed through standard image definition, by cost, or by updating of available materials.
Author

N88-25954# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
REMOTE SENSING APPLIED TO THE MONITORING OF MINERAL EXTRACTION IN THE PROXIMITY OF URBAN AREAS: PROS AND CONS [SENSORIAMENTO REMOTO APLICADO AO MONITORAMENTO DE EXTRACAO MINERAL EM PROXIMIDADES DE AREAS URBANAS: PROS E CONTRAS]
Dalton deMorissonValeriano *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 200-210 In PORTUGESE (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

Within the economic activities that are directly related to the exploration of natural resources, quarrying is one of those that causes great environmental disturbances. The lowering of the life qualtiy standard that generally follows environmental degradation justifies the need of a relatively high frequency monitoring of mineral extraction activity when it takes place in urban fringes. Due to its inherent periodicity, spaceborne remote sensing is potencially a fundamental tool to the execution of such monitoring. Nevertheless, due to the operational peculiarities of the activities and to the variability of materials envolved in the mineral extraction, the application of remote sensing to its monitoring requires methological attentions that are specific to each type of quarrying. These methodological aspects are discussed through the analysis of a case study; the coal mining in Southeastern Santa Catarina State.
Author

N88-25955# Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
AERIAL PHOTOGRAPHY AS AN INSTRUMENT OF ATMOSPHERIC ANALYSIS: MAPS OF THE MIDDLE ATMOSPHERE AND ITS DYNAMICS, BAIXADA SANTISTA (SP)
Frederico Herman, Jr. *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 211-231 (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

Topics addressed include: mapping of the middle atmosphere and its methodology; use of aerial photographs; toponymy and topography; hydrography and hydrology; climatic conditions; cultivation; surface degradation; water pollution; and air pollution.
B.G.

N88-25956# TerraFoto S.A., Sao Paulo (Brazil).
APPLICATION OF INTERACTIVE GRAPHIC SYSTEM (CAD/CAM) IN THE DETERMINATION OF PROCESS EVOLUTION IN LAND USE IN THE RIBEIRAO PRETO MUNICIPALITY
Antonio Carlos Cavalli *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 232-262 (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

This work has the objective to establish a computerized system which permits storage and recovery of updated information from graphic and nongraphic data in land use in the Sao Paulo State. The base of this work is composed of the comparison of cuts in time, represented through surveying the land use in Ribeirao Preto Municipality accomplished in 1962 through the Instituto Agronomico de Campinas and through photointerpretation of the 1983/84 aerial photos, taken over the same area. The dynamics of land use was evidenced through the intersection of the data of the municipality soil map with thte transitory and sugar cane cultivation, existing at the time of flight photographs. The method of systematic sampling by grid points was utilized, sighting the system of UTM coordinates, approving the establishment of address geography necessary in the intersection of information. The data thus obtained was processed by an interactive graphics system (CAD/CAM) which permits quantification of space-time evolution in municipal land use.
Author

N88-25957# EMPLASA, Sao Paulo (Brazil).
AERIAL PHOTOGRAPHY AS AN INSTRUMENT OF MUNICIPAL AND REGIONAL PLANNING: METROPOLITAN AREA OF SAO PAULO (SP)
Flavio SammarcoRosa *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 263-279 (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

This work analyzes aerial photography as a more antiquated sensor system and used in Brazil since 1930, citing some of the more important stratifications in the Sao Paulo State. After some conceptual aspects are examined, aerial photography is highlighted as an important resource for obtaining information, connecting the various sciences which study space geography, which affects the survey of natural resources and which analyzes and plans human intervention in the middle atmosphere. The utilization of aerial photography is singled out for the accomplishment of the cartographic base of the municipality or region, as the basis for

the implantation and moderization of the municipal cadaster technique and for elaboration of thematic mapping, which offers fundamental information and regional administration. Author

N88-25958# Juruena Empreendimentos de Colonizacao Ltda., Sao Paulo (Brazil).
REMOTE SENSING APPLIED TO INTEGRATED REGIONAL DEVELOPMENT PROGRAMS
Jose Antonio CasanovaSantosMatos *In* Instituto de Pesquisas Espaciais, National Meeting on Remote Sensing Applied to Municipal Planning 1987 p 280-288 (For primary document see N88-25939 19-43)
Avail: NTIS HC A14/MF A01

Some of the utilizations of remote sensing, which are routinely used for the elaboration and implantation of the Colonization Project, are cited in generic form. Although it is evident that this utilization is far from being exhausted, excellence is possible by the utilization of this technique, principally facing great dimensions and extreme complexity, which covers the Colonization Project. Therefore, it can be concluded that remote sensing, which today is the fundamental instrument in the Colonization Project, tends to be more and more an element of economic resources, efficiency, and speed of the whole process, contributing to the viability of the initial private participation in the undertakings for integrated regional development. Author

N88-25959# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.
SPACECRAFT REQUIREMENTS FOR PREDICTIONS OF GEOMAGNETIC ACTIVITY (A TUTORIAL)
Alfred L. Vampola 1 Mar. 1988 21 p
(Contract F04701-85-C-0086)
(AD-A191943; TR-0086A(2940-05)-9; SD-TR-88-45) Avail: NTIS HC A03/MF A01 CSCL 22A

Operational and research spacecraft require predictions of geomagnetic activity due to various effects of the geomagnetic activity on their operation. At high altitude, electrical charging of spacecraft surfaces, which occurs as a result of hot plasma injected from the geomagnetic tail during substorms, can produce discharges which result in spurious operation of the spacecraft. A reliable prediction of such activity can permit additional vigilance on the part of ground controllers at times of possible spurious operation of the spacecraft. Large magnetic disturbances, which accelerate electrons to high energies in the magnetosphere, increase backgrounds in sensors such as star sensors used for attitude control and also can produce spurious operation through the mechanism of thick dielectric charging which also produces discharge pulses. Again, reliable prediction of such magnetic storms, which requires a knowledge of solar wind conditions, would be of great value in operational management of space assets. For low altitude spacecraft which are subject to orbit perturbations as a result of changes in atmospheric scale height, constituent density, and temperature, operational procedures can also benefit from a predictive capability of geomagnetic activity which is closely linked to modifications of the atmospheric density profile. GRA

N88-25960*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
USING SPACE PHOTOGRAPHY OF THE EARTH IN THE CLASSROOM: DROUGHT IN AFRICA
Margaret C. Kinsler Oct. 1986 15 p Submitted for publication Original contains color illustrations
(Contract NAS9-15800)
(NASA-CR-182948; NAS 1.26:182948) Avail: NTIS HC A03/MF A01 CSCL 14E

A script of a classroom presentation based on space photographs of Africa is presented. The intended audience is elementary and secondary school teachers. Photographs of Lake Chad are used to illustrate climatic developments that exemplify the African drought problem. J.P.B.

N88-25961*# California Univ., Santa Barbara. Dept. of Geography.
CANOPY REFLECTANCE MODELING IN A TROPICAL WOODED GRASSLAND Final Report
David Simonett 13 Jun. 1988 113 p
(Grant NAGw-788)
(NASA-CR-182981; NAS 1.26:182981) Avail: NTIS HC A06/MF A01 CSCL 02C

The Li-Strahler canopy reflectance model, driven by LANDSAT Thematic Mapper (TM) data, provided regional estimates of tree size and density in two bioclimatic zones in Africa. This model exploits tree geometry in an inversion technique to predict average tree size and density from reflectance data using a few simple patameters measured in the field and in the imagery. Reflectance properties of the trees were measured in the study sites using a pole-mounted radiometer. The measurements showed that the assumptions of the simple Li-Strahler model are reasonable for these woodlands. The field radiometer measurements were used to calculate the normalized difference vegetation index (NDVI), and the integrated NDVI over the canopy was related to crown volume. Predictions of tree size and density from the canopy model were used with allometric equations from the literature to estimate woody biomass and potential foliar biomass for the sites and for the regions. Estimates were compared with independent measurements made in the Sahelian sites, and to typical values from the literature for these regions and for similar woodlands. In order to apply the inversion procedure regionally, an area must first be stratified into woodland cover classes, and dry-season TM data were used to generate a stratum map of the study areas with reasonable accuracy. The method used was unsupervised classification of multi-data principal components images. Author

N88-25962 Societe Guilleminot-Noespflug et Cie, Paris (France).
NEW DUPLICATING PAPER WITH HIGH RESOLUTION FOR AERIAL PHOTOGRAPHY Final Report
G. Gerard 1987 35 p In FRENCH
(PB87-228706) Avail: NTIS HC E04/MF E04; copy not available from STI Facility CSCL 09E

Photographic papers with high resolution for duplication of silver films for aerial photographs were investigated and developed. The properties of the paper to be developed are listed. Taking into account the work done previously, the goal was to perfect a process which is at the same time accurate and simple, allowing the duplication of silver films for aerial photographs. Author

N88-25963# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SEPARABILITY OF CULTIVATION THROUGH DIGITAL ANALYSIS OF SPOT AND TM DATA
Getulio Teixeira Batista, Sherry Chou Chen, Antonio Tebaldi Tardin, and Jean Francois Dallemand May 1988 16 p In PORTUGUESE; ENGLISH summary Presented at the 2nd Latin-American Symposium on Remote Sensing, Bogota, Colombia, 16-20 Nov. 1987
(INPE-4541-PRE/1287) Avail: NTIS HC A03/MF A01

The objective was to evaluate SPOT and TM data for spectral discrimination of coffee, wheat, sugar cane, and pasture in the Northwest of Parana State. The test site comprises a SPOT scene of approximately 60 x 60 km. Fifteen fields were analyzed for each crop. Field information such as variety, planting date, phenological stage, row space, planting direction, percent soil cover was obtained. Wheat was initially considered as two classes according to its growing stage. Data were analyzed using one SPOT scene (5.3 deg off nadir, east viewing) acquired on July 10, 1986 and one TM scene from August 2, 1986. J-M distance was calculated taking into account several classes and band combinations from both SPOT/HRV and LANDSAT-TM. The best TM band combination for crop discrimination was determined. Separability analysis of crops using SPOT and TM images is presented. Author

N88-26053# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
OVERVIEW OF SPACE MISSIONS AND TECHNIQUES FOR OCEAN MONITORING
N. deVilliers *In its* Proceedings of the Colloquium on Space and Sea Mar. 1988 p 265-272 (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26055# International Chamber of Shipping, London (England).
THE CONTRIBUTION OF SPACE TO MARITIME ACTIVITIES
M. A. Calder *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 281-286 (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26056# Centre National d'Etudes Spatiales, Toulouse (France).
SENSORS IN SPACEBORNE OCEANOGRAPHY [LES CAPTEURS EN OCEANOGRAPHIE SPATIALE]
M. Avignon and M. Dorrer *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 287-296 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26057# Direction de la Meteorologie Nationale, Paris (France).
CONTRIBUTION OF SPACE TO MARINE ACTIVITIES [APPORT DE L'ESPACE AUX ACTIVITES MARITIMES]
Francois Gerard *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 299-303 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26063# Centre National de la Recherche Scientifique, Paris (France).
CONTRIBUTION OF SPACEBORNE HIGH RESOLUTION RADIOMETERS TO MAPPING OF PRECOASTAL DEPTHS [APPORTS RADIOMETRES A HAUTE RESOLUTION SPATIALE POUR LA CARTOGRAPHIE DES HAUTS FONDS PRE LITTORAUX]
A. T. Diaw, E. Guillemot, L. Menanteau, Y.-F. Thomas, R. Zbinden, and C. A. A. Amaya *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 333-338 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26064# Observatoire de Paris-Meudon (France).
STUDY OF THE ARACHON (FRANCE) UNDERWATER DELTA USING THEMATIC MAPPER DATA [ETUDE DU DELTA SOUS-MARIN D'ARCACHON D'APRES DES DONNEES DU THEMATIC MAPPER]
Dong Chen He, J. LeRhun, and Li Wang *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 339-343 In FRENCH; ENGLISH summary (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N88-25964# Metalux S.p.A., Musile di Piave (Italy).
SOLAR ASSISTED ABSORPTION OR MOTOR DRIVEN HEAT PUMP WITH EARTH SEASONAL STORAGE. PART 2: TABLES AND FIGURES Final Report, 1 Jul. 1982 - 30 Aug. 1985
R. M. Lazzarin 1986 104 p
(DE88-900226; EUR-10614-Pt-2) Avail: NTIS (US Sales Only) HC A06/MF A01

A plant composed of an energy roof, a seasonal earth storage and an absorption heat pump has been tested. The purpose was to study the behavior of the various components and their interaction. The surveys went on during two years. The following operations are considered: the charging of the earth storage by the energy roof and the working of an absorption heat pump connected either to the energy roof or to the earth storage. This volume contains all the findings. DOE

N88-25965# AiResearch Mfg. Co., Torrance, Calif.
ADVANCED ENERGY SYSTEM PROGRAM Annual Report, Jun. 1986 - Feb. 1987
K. Trester Jun. 1987 119 p Sponsored in part by Southern California Gas Co., Los Angeles, Brooklyn Union Gas Co., N.Y. and Pacific Gas and Electric Co., San Francisco, Calif.
(Contract GRI-5084-243-1028)
(PB88-183025; DOC-87-60676; GRI-87/0340) Avail: NTIS HC A06/MF A01 CSCL 10B

The ogjectives are to design, develop, and demonstrate a natural-gas-fueled, highly recuperated, 50 kw Brayton-cycle cogeneration system for commercial, institutional, and multifamily residential applications. Recent marketing studies have shown that the Advanced Energy System (AES), with its many cost-effective features, has the potential to offer significant reductions in annual electrical and thermal energy costs to the consumer. Specific advantates of the system that result in low cost ownership are high electrical efficiency (34 percent, LHV), low maintenance, high reliability and long life (20 years). Significant technical features include: an integral turbogenerator with shaft-speed permanent magnet generator; a rotating assembly supported by compliant foil air bearings; a formed-tubesheet plate/fin recuperator with 91 percent effectiveness; and a bi-directional power conditioner to ultilize the generator for system startup. The planned introduction of catalytic combustion will further enhance the economic and ecological attractiveness. GRA

N88-25966# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Technical Physics.
FAST PARAMETRIZATION PROCEDURE FOR SOLAR CELLS
P. D. Lund and T. Pylkkaenen 15 Jul. 1987 22 p
(PB88-186416; TKK-F-A615; ISBN-951-754-229-1) Avail: NTIS HC A03/MF A01 CSCL 10A

A simple mathematical procedure is presented for the parameterization of the temperature dependent solar cell current-voltage characteristics by using standard measured data. The silicon cells studied here are described by five parameters. The method has been applied to several different photovoltaic modules, the inaccuracy of fit being less than 1.0 percent in all studied cases. On an IBM XT PC compatible microcomputer, a parameter fit requires an average 50-100 seconds. The model is well applicable for engineering purposes. GRA

N88-25967# Resource Analysis International, Inc., Los Angeles, Calif.
INTEGRATED SOLAR REFORMING FOR THERMOCHEMICAL ENERGY TRANSPORT

T. Rozenman Dec. 1987 161 p
(Contract DE-AC04-76DR-00789)
(DE88-005010; SAND-87-8181) Avail: NTIS HC A08/MF A01

This report presents a design study of two reforming processes as applied to the concept of solar thermochemical energy transport. Conceptual designs were carried out for steam-methane and CO2-methane reforming plants. A solar central receiver reformer was designed as an integrated reactor with the chemical reaction tubes placed inside the receiver cavity. The two plant designs were compared for their energy efficiency and capital cost. The CO2 reforming plant design results in higher energy efficiency but requires a catalyst which is still in an experimental stage of development. A third design was performed as a modification of the steam reforming plant utilizing a Direct Contact system, in which the process steam is generated by utilizing the heat of condensation. This system resulted in the highest energy efficiency. A comparison of the capital cost of these three plant designs shows them to be equivalent within the estimation accuracy of 25 percent. DOE

N88-25968# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
PHOTOVOLTAIC ENERGY SYSTEMS Program Summary Report, fiscal year 1987
Feb. 1988 238 p
(Contract DE-AC02-83CH-10093)
(DE88-007504; DOE/CH-10093/H4) Avail: NTIS HC A11/MF A01

An overview is provided of the activities within the National Photovoltaics Program. Tasks conducted by the participating national laboratories or under contract by industrial, academic and other research institutions are highlighted. Activities initiated, renewed, or completed during Fiscal Year 1987 are covered. The listing for each activity provides the task title, objectives, approach, status and accomplishments, milestones, major project reports, the name of the contractor and principal investigator, the directing organization, and the contract funding information. Publications for FY86-87 are also listed. DOE

N88-25969# Brookhaven National Lab., Upton, N. Y.
CHEMICAL/HYDROGEN ENERGY SYSTEMS Annual Report, 1 Jan. - 31 Dec. 1986
Jun. 1987 208 p
(Contract DE-AC02-76CH-00016)
(TI88-007013; BNL-40235) Avail: NTIS HC A10/MF A01

This report describes activities conducted during 1986 within the Chemical/Hydrogen Energy Systems (C/HES) Program, for which Bookhaven National Laboratory provides technical and management support to the U.S. Department of Energy. Research and exploratory efforts under this program have been directed towards developing a base technology that will apply to hydrogen production, storage, and transport. Major areas of interest include: (1) High Temperature Water Vapor Electrolysis for Hydrogen Generation (Westinghouse); (2) Evaluation of Materials for Medium Temperature Water Vapor Electrolysis; (3) Cryoadsorption of Hydrogen on Activated Carbon (Syracuse). Contributions in 1986 made by private sector contractors, university, researchers, and BNL in-house technical staff are summarized in the report. Also included is a summary of related International Energy Agency (IEA) cooperative efforts as well as plans and major activities scheduled for 1987. DOE

N88-25970*# Arkansas Univ., Fayetteville. Dept. of Electrical Engineering.
STUDY OF STAEBLER-WRONSKY DEGRADATION EFFECT IN A Si:H BASED P-I-N SOLAR CELLS Semiannual Report
Hameed Naseem and A. M. Herman Jul. 1988 23 p
(Grant NAG3-802)
(NASA-CR-182564; NAS 1.26:182564) Avail: NTIS HC A03/MF A01 CSCL 10A

The objective of this study is to improve the stability and efficiency of thin solar cells with emphasis on a-Si:H devices. The research project was broken down into three main phases. The first involves designing and building a UHV glow discharge system; the second involves making good quality films and eventually efficient cells; the final phase will be analytical. Author

N88-25971# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
THE MOD-2 WIND TURBINE: AEROACOUSTICAL NOISE SOURCES, EMISSIONS, AND POTENTIAL IMPACT
N. D. Kelley, H. E. McKenna, E. W. Jacobs, R. R. Hemphill, and N. J. Birkenheuer Jan. 1988 212 p
(Contract DE-AC02-83CH-10093)
(DE88-001132; SERI/TR-217-3036) Avail: NTIS HC A10/MF A01

This report summarizes research into characteristics of acoustic noise emissions of the DOE/NASA MOD-2 wind turbine. The results of this study showed that the MOD-2 noise levels are well below annoyance thresholds within residential structures a kilometer or more from the turbine rotor. It was also found that the inflow turbulent structure has a major influence on the level and characteristics of the low-frequency-range (2 to 160 Hz) acoustic emissions which, in turn, have implications for the associated structural response of the rotor assembly. The high-frequency-range (A-weighted) levels were found to vary primarily with the mean hub-height wind speed. The rotor inflow turbulence characteristics at the Goodnoe Hills site were found to be controlled almost entirely by the diurnal variation in the vertical stability of the first 100 m of the atmospheric boundary layer. DOE

N88-25972# Electrotek Concepts, Inc., Knoxville, Tenn.
ANALYSIS OF THE ELECTRICAL HARMONIC CHARACTERISTICS OF A SLIP RECOVERY VARIABLE SPEED GENERATING SYSTEM FOR WIND TURBINE APPLICATIONS
J. I. Herrera and T. W. Reddoch Feb. 1988 36 p
(Contract DE-AC02-83CH-10093)
(DE88-001140; SERI/STR-217-3268) Avail: NTIS HC A03/MF A01

Variable speed electric generating technology can enhance the general use of wind energy in electric utility applications. This enhancement results from two characteristic properties of variable speed wind turbine generators: an improvement in drive train damping characteristics, which results in reduced structural loading on the entire wind turbine system, and an improvement in the overall efficiency by using a more sophisticated electrical generator. Electronic converter systems are the focus of this investigation -- in particular, the properties of a wound-rotor induction generator with the slip recovery system and direct-current link converter. Experience with solid-state converter systems in large wind turbines is extremely limited. This report presents measurements of electrical performances of the slip recovery system and is limited to the terminal characteristics of the system. Variable speed generating systems working effectively in utility applications will require a satisfactory interface between the turbine/generator pair and the utility network. The electrical testing described herein focuses largely on the interface characteristics of the generating system. A MOD-O wind turbine was connected to a very strong system; thus, the voltage distortion was low and the total harmonic distortion in the utility voltage was less than 3 percent (within the 5 percent limit required by most utilities). The largest voltage component of a frequency below 60 Hz was 40 dB down from the 60-Hz less than component. DOE

N88-25973# Department of Energy, Oak Ridge, Tenn. Office of Scientific and Technical Information.
OCEAN, WAVE, AND TIDAL ENERGY SYSTEMS: CURRENT ABSTRACTS
L. Smith, ed. and D. W. Lane, ed. Jan. 1988 7 p
(DE88-008299; DOE/OES-88-1) Avail: NTIS HC A02/MF A01

Ocean, Wave, and Tidal Energy Systems (OES) announces on a bimonthly basis the current worldwide information available on all aspects of ocean thermal energy conversion systems based on exploitation of the temperature difference between the surface water and ocean depth. All aspects of salinity gradient power systems based on extracting energy from mixing fresh water with

seawater are included, along with information on wave and tidal power. This publication contains the abstracts of DOE reports, journal articles, conference papers, patents, theses, and monographs added to the Energy Data Base (EDB) during the past two months. Also included are U.S. information obtained through acquisition programs or interagency agreements and international information obtained through the International Energy Agency's Energy Technology Data Exchange or government-to-government agreements. DOE

N88-25974# Sandia National Labs., Albuquerque, N. Mex.
LIQUID METAL THERMAL ELECTRIC CONVERTER THEORETICAL AND EXPERIMENTAL STUDIES
J. B. Moreno, J. P. Abbin, C. E. Andraka, and L. L. Lukens 1988 13 p Presented at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. 1988
(Contract DE-AC04-76DP-00789)
(DE88-008806; SAND-87-2965C; CONF-880702-3; CONF-880702) Avail: NTIS HC A03/MF A01

The Liquid Metal Thermal Electric Converter (LMTEC) is a thermodynamic heat engine with no moving parts that has the potential for high efficiency and low operating and maintenance costs in a number of terrestrial and space applications. At Sandia National Laboratories, the LMTEC has been studied theoretically and experimentally as a candidate for solar dish electric systems. The primary goals have been to improve and adapt the existing technology to solar requirements. As part of this effort, a 25-kWe solarized LMTEC conceptual design was produced and a bench test module (BTM) was constructed and tested. The BTM incorporated a number of new design innovations that were conceived especially for a solarized LMTEC. The maximum electrical power extracted from the BTM was a small fraction of the level expected. Using a detailed computer model for BTM performance, the major results were shown to be consistent with high electrode flow resistance. The same conclusion was reached using a new experimental electrode evaluation technique. Thus the performance was limited by the particular electrode that was used and not in any fundamental way be the design innovations. DOE

N88-25975# Oak Ridge National Lab., Tenn.
C-CAMP: A CLOSED CYCLE ALKALI METAL POWER SYSTEM
R. P. Wichner and H. W. Hoffman 1988 7 p Presented at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. 1988
(Contract DE-AC05-84OR-21400)
(DE88-009715; CONF-880702-4; CONF-880702) Avail: NTIS HC A02/MF A01

A concept is presented for a Closed-Cycle Alkali Metal (C-CAMP) power systems which utilizes the heat of reaction of an alkali metal and halogen compound to vaporize an alkali metal turbine fluid for a Rankine cycle. Unique features of the concept are: (1) direct contact (heat exchange) between the reaction products and turbine fluid, and (2) a flow-through chemical reactor/boiler. The principal feasibility issues of the concept relate to the degree of cross-mixing of product and turbine fluid streams within the reactor-boiler. If proven feasible, the concept may be adapted to a range of fuel and turbine fluids and ultimately lead to thermal efficiencies in excess of 35 percent. DOE

N88-25976# Argonne National Lab., Ill.
DIELECTRIC COMPOUND PARABOLIC CONCENTRATING SOLAR COLLECTOR WITH FRUSTRATED TOTAL INTERNAL REFLECTION ABSORBER
J. R. Hull 1988 33 p Presented at Solar '88: American Solar Energy Society Annual Meeting and 13th National Passive Solar Conference, Cambridge, Mass., 18 Jun. 1988
(Contract W-31-109-eng-38)
(DE88-009986; CONF-880615-2; CONF-880615) Avail: NTIS HC A03/MF A01

Since its introduction, the concept of nonimaging solar concentrators, as exemplified by the compound parabolic concentrator (CPC) design, has greatly enhanced the ability to collect solar energy efficiently in thermal and photovoltaic devices. When used as a primary concentrator, a CPC can provide significant concentration without the complication of a tracking mechanism and its associated maintenance problems. When used as a secondary, a CPC provides higher total concentration, or for a fixed concentration, tolerates greater tracking error in the primary. DOE

N88-25977*# AiResearch Mfg. Co., Torrance, Calif.
ADVANCED HEAT RECEIVER CONCEPTUAL DESIGN STUDY Final Report, Jul. 1986 - Nov. 1987
Hal J. Strumpf and Murray G. Coombs Dec. 1987 327 p
(Contract NAS3-24859)
(NASA-CR-180901; NAS 1.26:180901; AiResearch-87-61069)
Avail: NTIS HC A15/MF A01 CSCL 10A

A study was conducted to generate and evaluate advanced solar heat receiver concepts for orbital application with Brayton and Stirling engines approximately 7 kWe in size. The resulting designs have thermal storage capability, and will be lighter, smaller, and/or more efficient than baseline systems such as the configuration used for the Brayton solar receiver currently under development by Garrett AiResearch for the NASA Space Station. Author

N88-25978*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF LEO CYCLING AT SHALLOW DEPTHS OF DISCHARGE ON MANTECH IPV NICKEL-HYDROGEN CELLS
John J. Smithrick [1988] 9 p Presented at the 23rd Intersociety Energy Conversion Engineering Conference, Denver, Colo., 31 Jul. - 5 Aug. 1988; sponsored in part by ASME, AIAA, ANS, SAE, IEEE, ACS, and AIChE
(NASA-TM-101300; E-4122; NAS 1.15:101300) Avail: NTIS HC A02/MF A01 CSCL 10A

An individual pressure vessel nickel-hydrogen battery is being considered as an alternate for a nickel-cadmium battery on the Hubble Space Telescope. The space telescope battery will primarily be operating at a shallow depth of discharge (10 percent DOD) with an occasional 40 percent DOD. This shallow DOD raises several issues: (1) What is the cycle life. It is projected to be acceptable; however, there is no reported real time data base for validation. (2) The state of charge of the nickel electrode at the beginning of charge is 90 percent. Will this cause an acceleration of divergence in the battery individual cell voltages. (3) After prolonged cycling at 10 percent DOD, will there be enough capacity remaining to support the 40 percent DOD. (4) Is the state of charge really 90 percent during cycling. There is no reported real time data base at shallow depths of discharge. A data base to address the above issues was initiated. Author

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N88-25979# National Center for Atmospheric Research, Boulder, Colo.
MM4 (PENN STATE/NCAR (NATIONAL CENTER FOR ATMOSPHERIC RESEARCH)) MESOSCALE MODEL VERSION 4 DOCUMENTATION
E. Y. Hsie Jul. 1987 226 p
(Grant NSF ATM-87-09659)
(PB88-173232; NCAR/TN-293-STR) Avail: NTIS HC A11/MF A01 CSCL 13B

The document describes the general program design and data organization of the PSU/NCAR mesoscale model version 4(MM4). The basic model was developed in the Pennsylvania State University over the past 15 years and has undergone many changes and improvements over the last 3 years, largely as a result of increased resources made available by the Acid Deposition Modeling Project (ADMP) at NCAR. Description of the basic model structure and data organization is given in enough detail that a

user can begin to add to or modify the code for his own research. In the first chapter, the general structure is outlined. Chapter 2 describes all the PARAMETER statements used in the model. Chapter 3 presents a list of all the variables in common blocks. The individual subroutines are described in Chapter 4. Finally, job control language, the source code, and the modification deck needed are given in Chapter 5. GRA

N88-25980# National Oceanic and Atmospheric Administration, Silver Spring, Md. Air Resources Lab.
NOAA (NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION) METEOROLOGY DIVISION SUPPORT TO THE ENVIRONMENTAL PROTECTION AGENCY Summary Report, fiscal year 1985
H. J. Viebrock and E. M. Poole-Kober Nov. 1987 62 p
(PB88-179866; NOAA-TM-ERL-ARL-160) Avail: NTIS HC A04/MF A01 CSCL 13B

The Meteorology Division provided meteorological research and support to the Environmental Protection Agency. Basic meteorological support consisted of the application of dispersion models, and the conduct of dispersion studies and model evaluations. The primary reserch effort was the development and evaluation of air quality simulation models using numerical and physical techniques supported by field studies. Modeling emphasis was on the dispersion of photochemical oxidants and particulate matter on urban and regional scales, dispersion in complex terrain, and atmospheric processes related to the acid deposition problem. Highlights during FY-1985 included evaluation of the dividing streamline height concept for flow over and around terrain features, completion of the VALMET and MELSAR models for use in specific terrain situations; development of a preliminary version of the Regional Acid Deposition Model (RADM). GRA

N88-25981# Lawrence Livermore National Lab., Calif.
A PRIMER ON GREENHOUSE GASES
D. J. Wuebbles and J. Edmonds Mar. 1988 106 p Prepared in cooperation with Pacific Northwest Lab., Richland, Wash.
(Contracts W-7405-eng-48; DE-AC06-76RL-01830)
(DE88-007576; DOE/NBB-0083) Avail: NTIS HC A06/MF A01

This document provides a reference summarizing current understanding of basic information on greenhouse gases. Each of the gases included is recognized to be important to the future state of global atmospheric chemistry and climate. Included as greenhouse gases are those of direct radiative importance to climate, those that act as radiative precursors, and those of importance as intermediate constitutents because of their chemical activities. Knowns, unknowns and uncertainties for each gas are described. This document focuses on information relevant to understanding the role of energy and atmospheric chemical and radiative processes in the determination of atmospheric concentrations of greenhouse gases. DOE

N88-25982# Oak Ridge National Lab., Tenn.
A GLOSSARY FOR CARBON DIOXIDE AND CLIMATE
R. E. Millemann Mar. 1988 56 p
(Contract DE-AC05-84OR-21400)
(DE88-007885; ORNL/CDIAC-22) Avail: NTIS HC A04/MF A01

This glossary contains definitions of selected CO2-related terms as well as tables containing information related to CO2 climate. Each term is defined first, emphasizing its relationship to CO2 and climate, and then for many of the terms the definition is followed by a more detailed description. References to the literature from which the definitions were taken are listed at the end of the Glossary. DOE

N88-25983# Pacific Northwest Labs., Richland, Wash.
COMPOSITE, MESO-GAMMA SCALE DIAGNOSTIC MODELING
R. C. Easter and C. G. Lindsey Feb. 1988 9 p Presented at the NAPAP Atmospheric Chemistry Task Group Review, Knoxville, Tenn., 13 Mar. 1988
(Contract DE-AC06-76RL-01830)
(DE88-008189; PNL-SA-15692; CONF-880351-4) Avail: NTIS HC A02/MF A01

Pollutant processing by clouds and precipitation is demonstrated by diagnostic modeling, through which information is obtained on the relative importance of different scavenging processes and the relations between pollutant inflows to and outflows from clouds. A significant aspect of this work is that scavenging and cloud chemistry processes are modeled within meteorologically complex situations on a scale where cloud-scale motions are treated explicitly. The scavenging simulations with the PLUVIUS-2 model have focused on the processing of sulfur species. The simulations involve four pollutant species: sulfur dioxide (SO2), sulfate aerosol, hydrogen peroxide (H2O2), and ozone. Ammonia and nitric acid are not included. Besides gas and aerosol forms, the species can be dissolved or bound in any of the water forms treated in the CSU model: cloud water, rain, graupel, snow (aggregates), and ice crystals. The scavenging processes included in the model for these species are impaction and nucleation scavenging of aerosols, reversible gas scavenging, aqueous chemical reactions between SO2, H2O2, and ozone, and cloud microphysical processes that transfer water and pollutants from one form to another. DOE

N88-25984*# Georgia Inst. of Tech., Atlanta. School of Geophysical Sciences.
DIAGNOSTIC STUDIES OF THE HxOy-NzOy-O3 PHOTOCHEMICAL SYSTEM USING DATA FROM NASA GTE FIELD EXPEDITIONS Annual Interim Report
William L. Chameides [1988] 56 p
(Grant NAG1-786)
(NASA-CR-183038; NAS 1.26:183038) Avail: NTIS HC A04/MF A01 CSCL 13B

Spring 1084 GTE CITE-1 flight data from the field exercise was obtained from a GTE Data Archive Tape. Chemical and supporting meteorological data taken over the Pacific Ocean was statistically and diagnostically analyzed to identify the key processes affecting the concentrations of ozone and its chemical precursors in the region. The analysis was completed. The analysis of the GTE CITE-2 data is being performed in collaboration with Dr. D.D. Davis and other GTE scientists. Initial results of the analysis were presented and work begun on the paper describing the results. B.G.

N88-25985# Department of Energy, Washington, D. C.
HEALTH AND ENVIRONMENTAL CONSEQUENCES OF THE CHERNOBYL NUCLEAR POWER PLANT ACCIDENT
Jun. 1987 309 p
(DOE/ER-0332) Avail: NTIS HC A14/MF A01

The pattern of radioactive releases from the Chernobyl nuclear reactor accident of April 1986 is analyzed to provide estimates of possible future health effects in exposed populations. Appropriate environmental transport models are used to integrate data from affected countries in order to estimate present and future distributions of radiation doses to pertinent population groups. Based on the most recent risk projection methodology, estimates of possible increases in cancer mortality, in teratogenic effects, and in genetic effects are derived from these dose projections for population groups in the U.S.S.R., the U.S., and other regions of the Northern Hemisphere. Author

N88-25986# Purdue Univ., West Lafayette, Ind. School of Mechanical Engineering.
POLLUTANT FORMATION IN HETEROGENEOUS MIXTURES OF FUEL DROPS AND AIR
Arthur H. Lefebvre May 1987 250 p
(DOE/CE-50052/H1) Avail: NTIS HC A11/MF A01

A spray combustion apparatus is developed to provide a better understanding of the basic role of fuel chemistry in determining the amount and nature of pollutant emissions from gas turbines and diesel engines. Fuel is supplied to the flame zone through a circular array of 30 miniature airblast atomizers. The objective is to achieve a sensibly uniform mixture strength in the fuel-air mixture entering the flame zone. This, in turn, ensures uniform conditions

of temperature and chemical composition at any given axial distance downstream of the fuel injection plane. A feature of this fuel injection system is that it allows the mean drop size of the fuel spray to be varied while maintaining all other flow properties constant. Thus, experimental data concerning pollutant emissions can be acquired under controlled conditions of pressure, inlet air temperature, and fuel mean drop size, at any given axial distance downstream of the fuel injection plane. This means that all observed differences in pollutant formation can be attributed directly to variations in chemical properties. Data are presented to show the effects of variation in inlet air temperature, pressure, fuel-air ratio, fuel drop size, and fuel chemistry on pollutant emissions, with special emphasis on particulates. Author

N88-25987# RAND Corp., Santa Monica, Calif.
TIMING REGULATIONS TO PREVENT STRATOSPHERIC-OZONE DEPLETION
James K. Hammitt Apr. 1987 72 p
(R-3495-JMO/RC; ISBN-0-8330-0855-2) Avail: NTIS HC A04/MF A01

Because of current uncertainty about the likely extent of future ozone depletion and its effects in the biosphere, the central question for current policy is whether to adopt interim regulations to reduce potential ozone depleter emissions now, or to wait several years for improved information. From a global economic perspective, the problem is structured so that both strategies impose equivalent environmental risk. A critical probability is then defined so that immediate regulations will have lower expected cost if and only if the probability that regulations will be necessary exceeds this value. Thus, immediate regulations are cost-justified if and only if policymakers' estimate of the probability that emission reductions will be necessary exceeds the critical probability. Detailed information is incorporated into the model on the cost of reducing emissions and the likely growth of demand for potential ozone depleters. For a wide range of assumptions about the likely growth and elasticity of demand for potential ozone depleters, the possibility that technological innovation will reduce the cost of emission reductions, the date at which improved information will become available, and the horizon used for limiting emissions and calculating costs, the critical probability (initially calculated as 0.36) is remarkably consistent. This suggests that conclusions about appropriate policy should not be overly sensitive to the specific assumptions chosen. J.P.B.

N88-25988# General Accounting Office, Washington, D. C.
ACID RAIN: DELAYS AND MANAGEMENT CHANGES IN THE FEDERAL RESEARCH PROGRAM
Apr. 1987 76 p
(GAO/RCED-87-89; B-226428) Avail: NTIS HC A05/MF A01

Reports and results from the National Acid Precipitation Assessment Program (NAPAP) established in 1980 have been delayed because of a management change. Reasons for the delay come out of this investigation. Recommendations are made to improve the program, including hiring a deputy director for assessments to ensure that key documents are issued on a timely basis, and ensuring that NAPAP sufficiently assess the economic effects of acid rain, as required by law, so that decision makers will have improved information on the benefits and costs associated with various policy options. J.P.B.

N88-25989# Environmental Protection Agency, Research Triangle Park, N.C. Air and Energy Engineering Research Lab.
IMPACT ON OZONE ATTAINMENT OF CFC (CHLOROFLUOROCARBON) CONTROLS USED TO PREVENT FUTURE DEPLETION OF STRATOSPHERIC OZONE
D. L. Harmon and N. D. Smith Apr. 1988 19 p
(PB88-195177; EPA-600/D-88-074) Avail: NTIS HC A03/MF A01 CSCL 13B

The impact on ozone attainment of chlorofluorocarbon (CFC) controls used to prevent future depletion of stratospheric ozone is discussed. It has been decided that allocated quotas offer the most attractive approach to limiting the use of CFCs and brominated compounds (halons). This approach should provide for economically efficient reductions. Control options that might be used by industry to achieve the necessary CFC reductions are evaluated. The most likely long term control option which may be adopted by most application areas is a chemical substitute. With this option, it may be possible to eliminate 90 percent or more of the ozone depleting CFC emissions. A variety of control options hold promise for short term applicability. Some of the engineering controls may still be applied even after new chemical substitutes are in use, since the higher cost of these substitutes may justify recovery. Author

N88-25990# Brookhaven National Lab., Upton, N. Y.
SULFUR DIOXIDE-HYDROGEN PEROXIDE RELATIONSHIPS IN CLEAN AIR, CLOUDS, AND PRECIPITATION
S. E. Schwartz and P. H. Daum Jan. 1988 12 p Presented at the 195th Joint National Meeting of the American Chemical Society and the 3rd Chemical Congress of North America, Toronto, Ontario, 5 Jun. 1988
(Contract DE-AC02-76CH-00016)
(DE88-006352; BNL-40755; CONF-880604-4) Avail: NTIS HC A03/MF A01

In-cloud oxidation by H_2O_2 is a major route for conversion of atmospheric SO_2 to sulfate, as indicated by kinetic calculations for representative H_2O_2 concentrations and supported by the observation of mutual exclusivity of gaseous SO_2 and aqueous H_2O_2 in non-precipitating liquid-water stratiform clouds, which generally persist sufficiently for reaction to proceed to completion. Measurements reported here indicate the aqueous S(IV) and H_2O_2 are also mutually exclusive in surface precipitation samples, but that SO_2 and aqueous H_2O_2 often coexist in precipitating clouds. Gaseous SO_2 and H_2O_2 are also commonly simultaneously present in clear air; in the mixed layer either species maybe in excess, but H_2O_2 present with SO_2 in precipitating clouds is attributed to material dissolved in falling hydrometeors which has not had time to react with SO_2. This supported by model calculations evaluating the characteristic time and distance for reaction of aqueous H_2O_2 in droplets falling through an SO_2-containing layer. DOE

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N88-25991# Naval Ocean Systems Center, San Diego, Calif.
THE MUF (MAXIMUM USABLE FREQUENCY) (3000) AS AN INDICATOR FOR F-REGION VARIATIONS Final Report, Feb. 1986 - Aug. 1987
A. K. Paul Jan. 1988 105 p
(AD-A191655; NOSC/TR-1204) Avail: NTIS HC A06/MF A01 CSCL 04A

Ionograms recorded at Brighton, Colorado during the last sunspot maximum are still being studied. Samples show that the high quality and high temporal resolution of the data may yield new information about the dynamics of the ionosphere, especially in the F-region. F-region parameters from these data show that this part of the ionosphere is highly variable, with short periods of the order of fractions of an hour. This report explains why the maximum usable frequency (MUF) (3000) appears to be the most appropriate indicator for F-region variations. GRA

N88-25992# Massachusetts Inst. of Tech., Cambridge. Earth Resources Lab.
INFLUENCE OF SCATTERING ON SEISMIC WAVES: PHYSICAL MECHANISMS CONTRIBUTING TO ATTENUATION IN THE CRUST Scientific Report No. 2, 1 Aug. 1986 - 31 Jan. 1987
M. N. Toksoez, Ru-Shan Wu, and Denis P. Schmitt 30 Sep. 1987 59 p
(Contract F19628-86-K-0004; ARPA Order 5299; DA Proj. 6A1-0)

(AD-A191699; AFGL-TR-87-0276) Avail: NTIS HC A04/MF A01 CSCL 08K

The mechanisms contributing to the attenuation of earthquake ground motion in the distance range of 10 to 200 km are studied with the aid of laboratory data, coda waves and strong motion attenuation measurements in the northeastern United States and Canada and theoretical models. The relative contributions to attenuation of anelasticity of crustal rocks (constant Q), fluid flow and scattering are evaluated. Scattering is found to be strong with albedo of Bo - 0.9 and scattering extinction length of about 17 km. The intrinsic attenuation in the crust can be explained by a high constant Q (500 less than or = sub 0 2000) and a frequency dependent mechanism most likely due to fluid effects in rocks and cracks. A fluid-flow attenuation model gives a frequency dependence (Q approx Q sub 0 f to the 5th power) similar to those determined from the analysis of coda waves of regional seismograms. GRA

N88-25993# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.

OUTER ZONE ELECTRON PRECIPITATION PRODUCED BY A VLF TRANSMITTER

Alfred L. Vampola and C. D. Adams 1 Mar. 1988 39 p

(Contract F04701-85-C-0086)

(AD-A191944; TR-0086A(2940-05)-2; SD-TR-88-34) Avail: NTIS HC A03/MF A01 CSCL 04A

Using high resolution pitch angle measurements made by a magnetic focusing electron spectrometer on the S3-3 satellite while in the drift loss cone region of the magnetosphere, characteristics of fluxes of 108 keV to 654 keV electrons precipitated in the inner zone, in the slot region, and in the outer zone of the magnetosphere are all shown to be consistent with the precipitation having been produced by the same ground-based VLF transmitter, UMS. Pitch angle measurements are used to locate the longitude of precipitation. The temporal pattern of transmitter operation obtained from synoptic data from a ground-based VLF receiver is used along with drift-rate calculations to predict the electron energies as a function of L-shell which should be observable by the S3-3 instrument. The predicted energy response is then compared with the in-situ observations, getting complete agreement. Finally, wave-particle resonance calculations are made for each of the three regions. The study indicates that ground-based VLF transmitters, which have previously been shown to produce precipitation in the inner zone and slot regions, are almost certainly instrumental in precipitating electrons in the outer zone also. GRA

N88-25994# California Univ., Berkeley. Lawrence Berkeley Lab.

SEISMIC BODY WAVES AND THE EARTH'S INNER CORE Ph.D. Thesis

P. Cummins Dec. 1987 138 p

(Contract DE-AC03-76SF-00098)

(DE88-007395; LBL-24735) Avail: NTIS HC A07/MF A01

In this study short-period body wave sismograms are numerically modeled to investigate the sensivity of core phase waveforms to structure near the Earth's inner core boundary (ICB). A calculation technique is developed which is a hybrid combination of asymptotic and discrete-layer reflectivity methods, the former being applicable to the smoothly-varying layers of the mantle and outer core, whereas the latter is used for the more complicated structure near the ICB. This technique facilitates the consideration of a large number of different models for structure near the ICB. DOE

N88-25995# International Centre for Theoretical Physics, Trieste (Italy).

PROPAGATION OF LINEAR GRAVITY WAVES IN A RELATIVISTIC ATMOSPHERE

A. R. Bestman Jul. 1987 8 p

(DE88-702062; IC-87/176) Avail: NTIS (US Sales Only) HC A02/MF A01

The propagation of gravity waves in the presence of massive stellar winds is studied under the assumption of small departures from the equilibrium configuration. These waves exhibit singular properties at critical levels which act like valves so that waves may travel through these levels attenuated or amplified. The primary conclusion is that relativity increases the possibility of valve effect. DOE

N88-25996*# Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.

DYNAMICS EXPLORER DATA ANALYSIS Semiannual Report, 15 May 1987 - 15 May 1988

Patricia H. Reiff 13 Jul. 1988 8 p

(Grant NAG5-775)

(NASA-CR-181428; NAS 1.26:181428) Avail: NTIS HC A02/MF A01 CSCL 04A

The project has shown unambiguously that auroral acceleration is caused by electric fields aligned parallel to the Earth's magnetic field. Evidence was shown of significant ion heating as ions are accelerated upwards in auroral electric fields. This heating is most likely caused by the two-stream instability. The fate of upward ion beams associated with auroral arcs is shown; they appear in the opposite hemisphere as dispersive ion precipitation events. Magnetic merging of the Interplanetary Magnetic Field occurs with both closed dayside magnetospheric field lines and open tail lobe field lines simultaneously nearly 30 percent of the time. The sunward flow in the dawnside plasma sheet is 20 percent smaller, on average, than in the duskside. The convection throat is displaced slightly more toward dawn for B sub y greater than 0 than for B sub y less than 0. J.P.B.

N88-25997 Oregon State Univ., Corvallis.

CHANGES IN SEISMIC VELOCITY AND APPARENT ATTENUATION DUE TO ISOTROPIC AND ANISOTROPIC SCATTERING: RESULTS FROM PHYSICAL MODELING Ph.D. Thesis

Bruce H. Dubendorff 1987 113 p

Avail: Univ. Microfilms Order No. DA8720537

Two physical modeling experiments (one three-dimensional and one two-dimensional) are used to investigate the scattering of seismic waves from small scale heterogeneities and the changes in seismic velocity and apparent attenuation resulting from this scattering. The effects of both isotropic and anisotropic scattering on velocity and apparent attenuation are calculated. The theory used for isotropic scattering for the three-dimensional experiment is a modified version of Wu's single scattering theory, where instead of calculating the scattering for a single scatterer using the Born approximation, the exact results for scattering from a cylindrical shape are used. Many theories used to test anisotropic scattering predict changes in velocity rather than changes in apparent attenuation. The velocity changes are used primarily due to geometrical focusing by a seismic lens that biases the amplitudes at low frequencies where most theories predict apparent attenuation. The anisotropic experimental results have similar shapes to both theoretical anisotropic methods for compressional waves and the theoretical anisotropic crack method for shear waves. Attenuation is computed using log spectral ratios and compares as well with the theoretical results as can be expected within the limits set. A method using anisotropic apparent attenuation to help quantify the scatterers is developed for use with field data. Dissert. Abstr.

N88-25998# Air Force Geophysics Lab., Hanscom AFB, Mass. Ionospheric Physics Div.

SCALING LAWS FOR GEOMAGNETIC TAIL CURRENT SHEET ACCELERATION

Christopher Sherman 22 Jul. 1987 12 p

(AF Proj. 2310)

(AD-A193379; AFGL-TR-87-0235; ERP-981) Avail: NTIS HC A03/MF A01 CSCL 04A

Solutions of the equation describing proton acceleration in the electric field of the Earth's geomagnetic tail often require lengthy numerical calculations and parametric exploration which can be difficult. Here, considerations of a scaling nature are presented,

and it is shown that these considerations may be used to extend, correlate, organize, and verify groups of solutions with regard to parametric variation. Author

N88-25999# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
THEORY ON CONDUCTIVITY MEASUREMENT TECHNIQUE FOR LANGMUIR PROBES IN THE STRATOSPHERE
I. R. C. A. Pinto and O. Pinto, Jr. Apr. 1988 19 p In PORTUGUESE; ENGLISH summary Presented at the 2nd Regional Meeting of Geophysics, Salvador, Brazil, 25-27 Nov. 1987 Submitted for publication
(Contract FINEP-537/CT)
(INPE-4514-PRE/1268) Avail: NTIS HC A03/MF A01

In this work, a theoretical development related to the technique of stratospheric conductivity measurments using Langmuir probes is presented. Such a technique, which was used in measurements on board stratospheric balloons, involves the determination of the relaxation time-constant associated with the probes. Considering a horizontal stratified atmosphere, this technique consists in shorting during a time interval two probes at different altitudes and then determining a time constant when the probes are refloated to the initial potentials. Although this technique was used by several authors, the exact relation between the relaxation time and the conductivity is not determined yet. This work determines such a relation showing also when this technique gives the total conductivity or only the positive or negative ones. Author

N88-26000# Uppsala Ionospheric Observatory (Sweden). Inst. of Space Physics.
INVESTIGATION OF THE SUN-ALIGNED F-REGION WALLS AND RELATED PHENOMENA IN THE AURORAL LATITUDE RANGE Final Scientific Report, 1 Mar. 1986 - 28 Feb. 1987
Ake Steen 21 Jul. 1987 57 p
(Grant AF-AFOSR-0084-84)
(AFGL-TR-87-0248) Avail: NTIS HC A04/MF A01 CSCL 04A

The final scientific report described the research activities in Kiruna utilizing ground based optical equipment, incoherent scatter radar, VIKING and HILAT satellites for the study of auroral processes. The development work of the optical instrumentation is summarized, and the current scientific work is reviewed. Author

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N88-26001# National Center for Atmospheric Research, Boulder, Colo.
ECMWF (EUROPEAN CENTRE FOR MEDIUM RANGE WEATHER FORECASTS) GLOBAL ANALYSES 1979-1986: CIRCULATION STATISTICS AND DATA EVALUATION
K. E. Trenberth and J. G. Olson Feb. 1988 96 p
(Grant NSF ATM-87-09659)
(PB88-178165; NCAR/TN-300-STR) Avail: NTIS HC A05/MF A01 CSCL 04B

In order to make optimal use of the data set of global analyses from the European Center for Medium Range Weather Forecasts (ECMWF), it is necessary to know of any problems that might exist and the effects of any changes in the operational system that produced the analyses. Tests were carried out of the internal consistency of the analyses, and known problems and changes in the operational system which resulted in major changes in characteristics of the analyses with time were summarized. Discontinuities are found in certain characteristics of the analyses. These give rise to spurious trends in the data and can lead to false impressions as to what the real anomalies are. At ECMWF the quantities most affected are the divergent wind and associated vertical velocity, and moisture. Monthly mean and long term mean statistics have been computed and are available on line at the National Center for Atmospheric Research (NCAR) along with the daily analyses on an R15 Gaussian grid compatible with the NCAR Community Climate Model processor. Documentation on how to access the data is provided. Eight year average general circulation statistics are presented. GRA

N88-26002*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SUGGESTED HURRICANE OPERATIONAL SCENARIO FOR GOES I-M
W. P. Menzel, R. T. Merrill (Wisconsin Univ., Madison.), and W. E. Shenk Dec. 1987 20 p
(NASA-TM-89729; NAS 1.15:89729; PB88-184817;
NOAA-TM-NESDIS-19) Avail: NTIS HC A03/MF A01 CSCL 04B

Improvements in tropical cyclone forecasts require optimum use of remote sensing capabilities, because conventional data sources cannot provide the necessary spatial and temporal data density over tropical and subtropical oceanic regions. In 1989, the first of a series of geostationary weather satellites, GOES 1-M, will be launched with the capability for simultaneous imaging and sounding. Careful scheduling of the GOES 1-M will enable measurements of both the wind and mass fields over the entire tropical cyclone activity area. The document briefly describes the GOES 1-M imager and sounder, surveys the data needs for hurricane forecasting, discusses how geostationary satellite observations help to meet them, and proposes a GOES 1-M schedule of observations and hurricane relevant derived products. GRA

N88-26003# National Oceanic and Atmospheric Administration, Boulder, Colo. Air Resources Lab.
GEOPHYSICAL MONITORING FOR CLIMATIC CHANGE, NUMBER 15 Summary Report, 1986
R. C. Schnell and R. M. Rosson Dec. 1987 168 p
(PB88-180146) Avail: NTIS HC A08/MF A01 CSCL 04B

At MLO, a major addition was construction of a 40-m walk-up tower to be used to increase the height of certain air sampling intakes and as a platform for special experiments. An astronomical dome and associated observation building were installed for the University of Arizona solar monitoring program. At BRW, new programs included weekly ozonesondes and gas chromatographs for in situ monitoring of CH4, CFC-11, CFC-12, N2O, CH3CCl3 and CCl4. The Dobson spectrophotometer used for total column ozone observations was reinstalled. Special efforts were made to support the AGASP-2 field program and for monitoring the radioactive cloud from the Chernobyl nuclear accident. GRA

N88-26004# National Oceanic and Atmospheric Administration, Washington, D. C. National Environmental Satellite, Data and Information Service.
SATELLITE OBSERVED MESOSCALE CONVECTIVE SYSTEM (MCS) PROPAGATION CHARACTERISTICS AND A 3-12 HOUR HEAVY PRECIPITATION FORECAST INDEX
J. Shi Dec. 1987 50 p
(PB88-180161; NOAA-TM-NESDIS-20) Avail: NTIS HC A03/MF A01 CSCL 04B

One of the greatest challenges of an operational meteorologist is predicting the direction and speed of movement of Mesoscale Convective Systems (MCS). In most cases, propagation is the controlling influence on the movement of MCSs. The type of propagation (backward or forward) often determines the amount of rainfall that occurs from a MCS. The memorandum briefly discusses previous concepts on thunderstorm propagation. Discussion and pertinent examples of MCS propagation characteristics observed in the GOES satellite imagery are presented. Two types of satellite propagation characteristics are identified. A short-range forecasting technique for expected storm propagation is described. Finally, a preliminary 3-12 hour heavy precipitation forecast index for MCSs is presented. GRA

N88-26005*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A STUDY OF THE DYNAMICS OF THE INTERTROPICAL CONVERGENCE ZONE (ITCZ) IN A SYMMETRIC ATMOSPHERE-OCEAN MODEL
J. G. Charney, E. Kalnay, E. Schneider, and J. Shukla (Maryland Univ., College Park.) Jun. 1988 24 p
(NASA-TM-86220; NAS 1.15:86220; MIT-87B0277) Avail: NTIS HC A03/MF A01 CSCL 04B

A numerical model of the circulation of a coupled axisymmetric atmosphere-ocean system was constructed to investigate the physical factors governing the location and intensity of the Intertropical Convergence Zone (ITCZ) over oceans and over land. The results of several numerical integrations are presented to illustrate the interaction of the individual atmospheric and oceanic circulations. It is shown that the ITCA cannot be located at the equator because the atmosphere-ocean system is unstable for lateral displacements of the ITCA from an equilibrium position at the equator. Author

N88-26006# Florida Univ., Gainesville. Dept. of Electrical Engineering.
VOLTAGES INDUCED BY LIGHTNING ON ELECTRIC POWER DISTRIBUTION LINES: FIELD DATA AND ANALYSIS RESULTS FOR THE PERIOD JULY 1984-1986
E. M. Thomson Mar. 1988 58 p
(Contract DE-AC05-84OR-21400)
(DE88-007841; ORNL/Sub-84-89650/1) Avail: NTIS HC A04/MF A01

Measurements have been made during 1984 and 1985 at the NASA Kennedy Space Center, Florida using a newly-developed spherical antenna of the time-domain horizontal and vertical electric fields from lightning return strokes. Statistics are presented for the fields of 42 return strokes. The peak horizontal field was about 0.03 of the peak critical field; the horizontal field had a mean risetime and a falltime to half value about 0.3 microsec prior to the peak in the vertical field. Voltage has also been measured at one end of an unenergized power distribution line about 500 m in length and 10 m in height. Tables of measured peak voltages are given. By way of a newly-written computer program, the line voltage has been calculated using the measured fields as inputs. Agreement between the voltage measurement and theory is generally good. The lightning horizontal electric field can significantly contribute to the induced line voltage. The horizontal fields become larger as the earth conductivity decreases. DOE

N88-26007# Finnish Meteorological Inst., Helsinki.
METEOROLOGICAL ASPECTS OF WET DEPOSITION IN SOUTHERN FINLAND
Pia Bremer 1987 47 p
(FMI-3) Avail: NTIS HC A03/MF A01

A 7 month study is presented on variabilities in the concentrations of sulfate, nitrate, and H(+) and the pH in precipitation collected at 3 hourly intervals at Suomusjarvi, Southern Finland, in 1982. The components displayed a similarity in temporal trend, expecially between sulfate and nitrate. The highest concentrations of sulfate and nitrate and lowest pH-values were associated with continuous rain, snow showers being the cleanest. The lowest concentrations were found in the smallest volumes of rain, but no general relationships between concentrations and rain volume could be observed. Trajectories calculated for six rain events with enhanced concentrations originated from intense and extensive high pressure areas, which had dominated large parts of Central Europe from five to six days. Typically, cold frontal rains brought in higher concentrations and lower pH than warm ones. There was an average decrease in sulfate between the first and the second sample in a frontal rain event, the mean ratio between these samples was 1.6. Between the second and the third sample an increase was found, the ratio now being 0.7. For nitrate the corresponding ratios were 1.7 and 0.8, respectively. Author

N88-26008# Finnish Meteorological Inst., Helsinki.
LAST SPRING FROSTS AND FIRST AUTUMN FROSTS IN FINLAND
Reijo Solantie 1987 60 p In FINNISH; ENGLISH summary
(FMI-6) Avail: NTIS HC A04/MF A01

The temporal distribution of the last frost in spring and the first one in autumn was studied separatively for ground frosts and hard frosts. The distribution of the duration of frost periods in spring was also examined. Finland may be divided into seven frost regions, and some of these into subregions. The division was made in conformity with the type of the underlying surface. South of the 62nd latitude hard frosts are during the period of June 15 to August 15 exceptional and ground frosts are practically absent from the archipelago and the areas around the inland lakes. Between the 62nd and 64th latitudes, small changes in mean minimum temperatures with height and amount of the lakes have a great influence on the duration of the absence period of hard frosts because mean minimum temperatures change only little shortly before and after midsummer. Farther north the summer night sun makes the peak of the seasonal course of minimum temperatures sharper, which lessens the risk of frosts and the variability of their ending and beginning. The frequency of the duration of spring frost periods decrease with duration having, however, in Northern Finland maxima for n x (5 to 6) d, where n = 1, 2, 3, or Author

N88-26009# Naval Oceanography Command Center/Joint Typhoon Warning Center, FPO San Francisco, Calif.
TROPICAL CYCLONE REPORT Annual Report
Carl W. Hoffman, Vernon G. Patterson, and Daniel J. McMorrow 1987 227 p
(AD-A191883) Avail: NTIS HC A11/MF A01 CSCL 04B

The contents of this report on tropical cyclones are as follows: Operational Procedures; Reconnaissance and Fixes; Summary of Western North Pacific and North Indian Ocean Tropical Cyclones; Summary of South Pacific and South Indian Ocean Tropical Cyclones; Summary of Forecast Verification; Tropical Cyclone Support Summary; and Tropical Cyclone Track and Fix Data. GRA

N88-26010*# National Aeronautics and Space Administration, Washington, D.C.
MRS-3000 METEOROLOGICAL ROCKET PROBE FOR THE MMR-06 DART INTEGRATED METEOROLOGICAL ROCKET SYSTEM
P. Gloede, K. H. Schulz, R. Stolte, E. Assenq, M. Fuchs, and G. Heinz Jun. 1988 8 p Transl. into ENGLISH of Issledovaniye Verkhney Atmosfery Zemli, (Trudy Tret-yego Mezhdunarodnogo Simpoziuma po Kosmicheskoy Meteorologii, g. Moskva, Aprel 1981), Leningrad (USSR), Gidrometeoizdat, 1984 Original language document was announced in IAA as A85-38603 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20303; NAS 1.77:20303) Avail: NTIS HC A02/MF A01 CSCL 04B

Described is the onboard equipment of a small meteorological rocket which uses a bead thermistor as an atmospheric temperature sensor as part of the MMR-06-DART unified rocket sounding network for operation in the USSR, the GDR, and Poland. Diagrams of the sounding rocket and of the sensor unit are presented, and the main technical characteristics are discussed. Author

N88-26011# Instituto de Pesquisas Espaciais, São Jose dos Campos (Brazil).
BOLETIM: AN EXPERT SYSTEM FOR WEATHER FORECASTING M.S. Thesis
Vera Helena deAvilaDuarte May 1988 317 p In PORTUGUESE; ENGLISH summary
(INPE-4538-TDL/329) Avail: NTIS HC A14/MF A01

BOLETIM is an expert system, the knowledge domain of which is meteorology, more specifically, the area of weather forecasting. Its task is to predict weather conditions in the State of Rio Grande do Sul, for a period of 24 hours. This task is based on the

interpretations of satellite photographs and surface and altitude maps. The process of knowledge acquisition has the colaboration of the National Meteorology Institute (INEMET). Actually, BOLETIM contains a set of 885 rules. The computational tool adapted for BOLETIM building was ESE/VM, using forward chaining as the inference mechanism. Author

N88-26012*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VERIFICATION OF REGIONAL CLIMATES OF GISS GCM. PART 1: WINTER
Leonard M. Druyan (National Academy of Sciences - National Research Council, Washington, D. C.) and David Rind Jan. 1988 51 p
(NASA-TM-100695; NAS 1.15:100695) Avail: NTIS HC A04/MF A01 CSCL 04B

Verification is made of the synoptic fields, sea level pressure, precipitation rate, 200 mb zonal wind and the surface resultant wind, generated by two versions of the GISS climate model. The models differ regarding the horizontal resolution of the computational grids and the specification of the sea surface temperatures. Maps of the regional distributions of seasonal variations of the model fields are shown alongside maps showing the observed distributions. Comparisons of the model results with observations are discussed, and also summarized in tables according to geographic regions. Author

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N88-26013 Harvard Univ., Cambridge, Mass.
MODELLING AND FORECASTING DEEP OCEAN AND NEAR SURFACE MESOSCALE EDDIES: HINDCASTING AND FORECASTING WITH, AND COUPLING A SURFACE BOUNDARY LAYER MODEL TO, THE HARVARD QUASIGEOSTROPHIC MODEL Ph.D. Thesis
Leonard John Walstad 1987 278 p
Avail: Univ. Microfilms Order No. DA8800862

Hindcasting and forecasting mid-ocean mesoscale flows with a quasi-geostrophic open ocean model is studied. The Harvard quasi-geostrophic open occan model was calibrated and documented by others. Here, these studies are synthesized and computationally introduced errors in the integration of the quasi-geostrophic equations are attributed. Combining the studies leads to some additional conclusions concerning the boundary conditions and the number of vertical levels. Issues related to the application of the model to data assimilation are focused upon. The initialization methodology is developed for a data set which consists of both temperature and velocity measurements and spans just over one year. A series of thirty standard hindcasts is presented. Comparing the hindcast fields with the data indicates that the primary reason for a hindcast which disagrees with the analyzed fields is a lack of data. A surface boundary layer model is coupled to the quasi-geostrophic model to provide a means for process studies of the near surface and as a data assimilation tool. A set of mesoscale boundary layer equations is derived. The result of this derivation is a set of equations which resemble the Ekman equations but include an arbitrary bulk parameterization of mixing within the surface boundary layer, horizontal, and vertical advection by the velocity fields of the interior flow, and an additional contribution to the divergence within the boundary layer. A Gulf Stream initialization is presented to demonstrate the applicability of the model to realistic ocean flows. Dissert. Abstr.

N88-26014*# National Aeronautics and Space Administration, Washington, D.C.
REMOTE DETERMINATION OF CHLOROPHYLL CONCENTRATION IN THE OCEAN USING AN OPTICAL PULSE RADAR
I. M. Levin and K. S. Shifrin Jun. 1988 13 p Transl. into ENGLISH from Distantsionnoye Opredeleniye Kontsentratsii Khlorofilla v Okeane s Pomoshchyu Opticheskogo Impulsnogo Lokatora, Issledovaniye Zemli iz Kosmosa (USSR), Jul.-Aug. 1987 p 12-19 Original language document was announced in IAA as A88-19562 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4307)
(NASA-TT-20301; NAS 1.77:20301) Avail: NTIS HC A03/MF A01 CSCL 08C

The potential of the pulse grating method to determine chlorophyll concentrations in the ocean are discussed. Relationships are derived for the power and energy of the echo signal. Two methods are proposed to calculate the water absorption coefficient, one for daytime applications and the other to be used at night. The radar energy sensitivity is evaluated (also in the presence of interfering sunlight). By way of example, required radar power and energy are calculated for real world conditions. Author

N88-26058# Centre National d'Etudes Spatiales, Toulouse (France).
THE FRENCH SPACEBORNE OCEANOGRAPHY PROGRAM [LE PROGRAMME FRANCAIS D'OCEANOGRAPHIE SPATIALE]
Jean-Louis Fellous and B. Voituriez (Ifremer, Paris, France) *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 305-310 In FRENCH (For primary document see N88-26016 19-51)
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N88-26060# Alcatel Thomson Espace, Toulouse (France).
DETERMINATION OF THE OCEAN CIRCULATION BY SPACEBORNE RADAR ALTIMETER
Pierre deChateau-Thierry *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 317-321 (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26061# Bureau Veritas, Courbevoie (France).
OCEAN SATELLITE DATA AND THE NEEDS OF DESIGNERS AND OPERATORS OF MARINE UNITS
Michel Huther and R. Nerzic (Elf Aquitaine, Pau, France) *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 323-325 In FRENCH; ENGLISH summary (For primary document see N88-26016 19-51)
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N88-26062# MATRA Espace, Paris-Velizy (France).
BATHYMETRY ESTIMATION BY ANALYZING SWELL ON SPOT IMAGES [ESTIMATION DE LA BATHYMETRIE PAR ANALYSE DE LA HOULE SUR IMAGE SPOT]
Yves Rabu, G. Ruckenbusch, and F. Barbereau *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 327-332 In FRENCH (For primary document see N88-26016 19-51)
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N88-26065# Ecole Nationale Superieure des Mines, Valbonne (France).
IMAGE PROCESSING APPLIED TO QUANTITATIVE NUMERICAL CARTOGRAPHY OF OCEAN CIRCULATION [TRAITEMENT D'IMAGES APPLIQUE A LA CARTOGRAPHIE NUMERIQUE QUANTITATIVE DE LA CIRCULATION OCEANIQUE]
B. Bianchi and L. Wald *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 345-347 In FRENCH (For primary document see N88-26016 19-51)
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N88-26066# Ecole Nationale Superieure des Mines, Valbonne (France).
METHODS FOR PROCESSING SATELLITE IMAGES AND THEIR APPLICATION TO UNDERWATER OPERATIONS [LES METHODES DE TRAITEMENT D'IMAGES SATELLITAIRES ET LEUR APPLICATION AUX TRAVAUX SOUS-MARINS]
L. Wald *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 349-351 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

51 LIFE SCIENCES (GENERAL)

N88-26015*# California Univ., San Diego, La Jolla. Dept. of Chemistry.
THE EVOLUTION OF GLUTATHIONE METABOLISM IN PHOTOTROPHIC MICROORGANISMS
Robert C. Fahey, Ralph M. Buschbacher, and Gerald L. Newton [1988] 29 p Submitted for publication
(Grant NAGw-342)
(NASA-CR-182902; NAS 1.26:182902) Avail: NTIS HC A03/MF A01 CSCL 06B

The low molecular weight thiol composition of a variety of phototropic microorganisms is examined in order to ascertain how evolution of glutathione (GSH) production is related to the evolution of oxygenic photosynthesis. Cells were extracted in the presence of monobromobimane (mBBr) to convert thiols (RSH) to fluorescent derivatives (RSmB) which were analyzed by high performance liquid chromatography (HPLC). Significant levels of GSH were not found in green sulfur bacteria. Substantial levels were present in purple bacteria, cyanobacteria, and eukaryotic algae. Other thiols measured included cysteine, gamma-glutamylcysteine, thiosulfate, coenzyme A, and sulfide. Many of the organisms also exhibited a marked ability to reduce mBBr to syn-(methyl,methyl)bimane, an ability which was quenched by treatment with 2-pyridyl disulfide or 5,5 prime-bisdithio - (2-nitrobenzoic acid) prior to reaction with mBBr. These observations indicate the presence of a reducing system capable of electron transfer to mBBr and reduction of reactive disulfides. The distribution of GSH in phototropic eubacteria indicates that GSH synthesis evolved at or around the time that oxygenic photosynthesis evolved. Author

N88-26016# European Space Agency, Paris (France).
PROCEEDINGS OF THE COLLOQUIUM ON SPACE AND SEA
T. D. Guyenne, ed. and J. J. Hunt, ed. Mar. 1988 339 p Partly in ENGLISH and FRENCH Colloquium held in Marseille, France, 24-27 Nov. 1987; sponsored by AAAF, Association Technique Maritime et Aeronautique, and Societe des Amis de l'ENSAE et de l'ENSTA
(ESA-SP-280; ISSN-0379-6566; ETN-88-92782) Copyright Avail: NTIS HC A15/MF A01

Living in a confined environment; living and workplaces in space and underwater; space and underwater robots; and the contribution of space to marine activities were discussed. For individual titles, see N88-26017 through N88-26066.

N88-26017# Direction des Constructions et Armes Navales, Toulon (France). Centre d'Etudes et de Recherches Techniques Sous-Marines.
PHYSIOLOGICAL EFFECTS ON MAN OF LONG DURATION CONFINEMENT IN A CARBON DIOXIDE ENRICHED ENVIRONMENT [EFFETS PHYSIOLOGIQUES CHEZ L'HOMME DU CONFINEMENT DE LONGUE DUREE EN ATMOSPHERE ENRICHIE EN DIOXYDE DE CARBONE] **c54**
Eugene Radziszewski, L. Giacomoni, and R. Guillerm *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 19-23 In FRENCH (For primary document see N88-26016 19-51)
(Contract DRET-79-1098)
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Eleven experiments of 6 to 46 days duration were performed on a total of 58 subjects in a climate chamber whose atmosphere was enriched at different partial pressures with carbon dioxide (PI-CO2 0.48 to 4.28 kPa, i.e., a concentration of 0.5 to 4.5 percent at a chamber pressure of 100 kPa). In a 46 day control experiment, the PI-CO2 was near 0, to evaluate the amplitude of effects linked to life in an enclosed space, to separate these effects from those purely due to CO2. Measurements conducted included analysis of breathed gases, acid-base equilibrium of the blood, hydromineral equilibrium, hematology, biorhythms, and psychmotor performance. Results reveal adaptation mechanisms of man to prolonged confinement and breathing involving different partial pressures of the CO2 intake, and enable acceptable limits of CO2 for enclosed spaces to be established. ESA

N88-26018# GKSS-Forschungszentrum Geesthacht (West Germany).
EXPERIENCE IN OCCUPATIONAL MEDICINE, DERIVED FROM 16 OPERATIONAL DEEP SATURATION TRIMIX 5 DIVES IN GUSI FROM 150 TO 600 m **c52**
Justus Holthaus *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 25-29 (For primary document see N88-26016 19-51)
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Based upon the physiological experience mainly of the Atlantis dive series, 16 operational deep saturation dives with 64 man dives, 1467 man days were performed in a strictly mono-parametrical way from 150 to 600 m, using 14 divers from different nations. Occupational health problems related to deep diving, hygiene, work, and intercurrent diseases are described. Conclusions are: safe operational diving is standard down to 300 m. Industrial application offshore is feasible to 450 m. The problems in the diving range from 450 to 600 m (HPNS, DCS, osteonecrosis) are still not satisfactorily solved. Neurological longterm effects have, so far not been observed. ESA

N88-26019# Compagnie Maritime d'Expertises, Marseille (France). Hydra Research Programme.
LIFE IN A HYPERBARIC ENVIRONMENT. A NEW O2-H2 BREATHING MIXTURE FOR INDUSTRIAL DIVING **c52**
Bernard Gardette, M. Comet, C. Gortan, J. P. Imbert, X. Fructus, and H. G. Delauze *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 31-40 (For primary document see N88-26016 19-51)
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A hydrogen/helium/oxygen gas mixture to open up the 300 to 600 m (1000 to 2000 ft) depth range to manned diving operations is introduced. Safety analyses and tests on mice and men are reviewed. The results of the use of hydrogen as a diluent for oxygen, either alone or in combination with helium, are positive. Once technical problems (such as oxygen adds, hydrogen leakage and removal) are overcome, and the handling mastered, this gas constitutes a solution to life under pressure. By virtue of its lightness and its anti-HPNS effect it gives the deep diver much greater comfort than heliox, which beyond 250 m depth induces joint pain, tremor, myoclonia, the muscular tension in turn lowering psychomotor performance, plus respiratory problems, reduced alertness, and poor sleep patterns. A diver breathing hydrogen is more efficient, less tired, and more comfortable, thus much safer while working in the water. ESA

N88-26020# Reims Univ., France. Lab. de Psychologie Appliquee.
STRESS IN RELATION TO THE PHYSICAL AND SOCIAL ENVIRONMENT [STRESS EN RAPPORT AVEC L'ENVIRONNEMENT PHYSIQUE ET SOCIAL] **c52**
Jean Rivolier *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 41-45 In FRENCH (For primary document see N88-26016 19-51)
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A man-environment interactional approach to stress is proposed, and the need to consider three levels, emotional, behavioral, and biological, is shown. The usefulness of wintering in polar regions

to study manifestations of stress, in particular in relation to soft stressors associated with long stays in isolated conditions in enclosed spaces, is presented. A method for selecting, training, and following up teams to be sent to the poles is suggested. Polar simulation of stressing conditions likely to be met by space crews is proposed. ESA

N88-26021# Bergen Univ. (Norway). Inst. of Physiological Psychology.

SELECTING THE RIGHT CREW FOR FUTURE SPACE STATIONS: AN ANALYSIS OF SELECTION RESEARCH ON OFFSHORE DIVERS, AVIATION PILOTS AND OTHER HIGH RISK GROUPS IN SCANDINAVIA **c53**

R. J. Vaernes, M. Warncke, T. Bergan, and Holger Ursin *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 47-51 (For primary document see N88-26016 19-51)

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Selection for high risk occupations, mainly pilots and offshore divers, using the Defense Mechanism Test (DMT) of Kragh (1960) is described. Longitudinal studies on serious nearmiss and fatal accidents (i.e., loss of aircraft); relationships to performance impairment in threatening situations; relationships to endocrine activation in threatening situations; and relationships to perceived health complaints and to physiological stress markers such as immunoglobuline levels are discussed, in view of selection criteria for manned space flights. Evidence shows that people with high defense strategies tend to have inadequate performance and high autonomic activation in threatening situations. Such subjects tend not to cope during training, and in the long term develop burn out problems. Multivariate analysis reveals three orthogonal (independent) endocrine factors with specific relations to psychological traits. A catecholamine factor relates to ambition and time urgency, and seems close to the Type A behavior described as being a cardiovascular risk. A cortisol factor relates to high defense mechanisms. The relation between an androgen and estrogen factor and personality is less stable. When an individual is faced with unsolved problems activation may become sustained and produce pathology through these personality-dependent endocrine reaction systems. It is shown that DMT level of prediction is many times greater than for other psychological tests which ignore the role of unconscious mental processes. ESA

N88-26022*# Institut Francais de Speleologie, Nice. Lab. Souterrain de Chronobiologie.

BIOLOGICAL RHYTHMS, SLEEP, AND WAKEFULNESS IN PROLONGED CONFINEMENT [RYTHMES BIOLOGIQUES, SOMMEIL ET VIGILANCE EN CONFINEMENT PROLONGE]

Michael Siffre *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 53-68 In FRENCH; ENGLISH summary Sponsored in cooperation with the Ministere des Armees, France, and the Ministere de l'Interieur, France (For primary document see N88-26016 19-51)

(Grant NsG-517)

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The dysynchronization of human circadian rhythms during 7 long-term (2 to 6 months) confinement experiments in temporal isolation in caves was studied. Five subjects abandon the circadian period of sleep and wakefulness (S-W) and spontaneously reach a circabidian S-W cycle (34 to 36 hr waking, 14 to 12 hr sleep) they maintain during weeks. Some subjects reach the 48 hr cycle very quickly (8 to 15 days), others after months. Polygraphic analyses of sleep show that rapid eye movement state (REMS) duration is directly proportional to the total duration of sleep and that the ultradian periodicity of REMS remains constant when S-W cycle is circadian or circabidian. When S-W cycle desynchronizes from circadian to circabidian, REMS and S-4 increase at the expense of stages I-2 and remain in constant relationship with the duration of previous wakefulness period. ESA

N88-26023# Centre d'Essais en Vol, Bretigny-Air (France). Lab. de Medecine Aerospatiale.

SPACE CABIN ATMOSPHERE AND EXTRACURRICULAR SORTIE [ATMOSPHERE D'UNE CABINE SPATIALE ET SORTIE EXTRA-VEHICULAIRE] **c54**

Henri Marotte and Marc Weibel (Avions Marcel Dassault-Breguet Aviation, Saint-Cloud, France) *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 69-76 In FRENCH (For primary document see N88-26016 19-51)

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Conditions which provoke aeroembolism were studied to help design space suits which reduce risks entailed in passing from the terrestrial like conditions of a spacecraft cabin atmosphere to the medium and low pressures of space suits. Design constraints on the suite and its pressurizing system were evaluated, especially for the working conditions of space stations, which require frequent extravehicuiar activity. Given the limits imposed by denitrogenation, a high pressure (at least 650 hPa) is suggested for the American space station program, whereas for ESA, use of Hermes is compatible with a 450 hPa suit. For intravehicular emergency suits, pressure should be as high as compatible with mobility requirements (bearing in mind the reduced level of physical activity). ESA

N88-26024# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

TECHNICAL CHALLENGES IN THE DEVELOPMENT OF A EUROPEAN SPACE SUIT SYSTEM AND COMPARISON WITH UNDERWATER SUITS **c54**

D. Isakeit *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 77-82 (For primary document see N88-26016 19-51)

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The key issues and the technical problems in the development of a European space suit system for extravehicular activity in the areas of crew enclosure, life support, information, and operations are compared to the problems associated with underwater suits. For design engineers of the space and the sea community, areas of common interest are reviewed in order to identify possible fields of cooperation. ESA

N88-26025*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

THE RELATIONSHIP BETWEEN PREFLIGHT UNDERWATER TRAINING AND SPACE MOTION SICKNESS

E. M. Youmans and K. L. Kreutzberg *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 83-85 (For primary document see N88-26016 19-51)

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Space Motion Sickness (SMS) severity was compared to WETF-(Weightless Environment Training Facility) trained and nontrained astronauts. Based on postflight medical debriefings, SMS severity was categorized as none, mild, moderate, and severe. The results show 63% of all crewmembers on their first shuttle flight experience SMS. Of those, 55% have symptoms ranked moderate to severe. From the nontrained group, 35% have no SMS, 18% mild, 29% moderate, and 18% severe. From the trained group, 41% have no SMS, 41% mild, 15% moderate, and 3% severe SMS. The results indicate an invérse relationship (p less than 0.01) between WETF training and SMS severity. Preflight WETF training may have operational significance as a viable countermeasure to SMS. ESA

N88-26026# Reims Univ., France. Lab. de Psychologie Appliquee.

SELECTION AND TRAINING OF SUBJECTS TO LIVE AND WORK IN HOSTILE AND UNUSUAL ENVIRONMENTS [SELECTION ET PREPARATION PSYCHOLOGIQUES DES SUJETS AYANT A VIVRE ET TRAVAILLER EN ENVIRONNEMENTS INHABITUELS ET HOSTILES] **c53**

Jean Rivolier and G. Cazes *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 87-89 In FRENCH (For primary document see N88-26016 19-51)

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A psychological approach to the selection and training of persons having to work in stressful environments is outlined. The need for selection at group and individual level is underlined. Experience shows that while it is easy to weed out unsuitable individuals, it is much harder to forecast behavior in adapting to unusual and hostile conditions. The approach includes cognitive, pschophysiological, and biological parameters as well as traditional psychological tests. For group selection, role playing and T-groups are used, along with observation of problem solving. Behaviorist and cognitive techniques are used during training to reinforce positive potential and reduce weaknesses in subjects. ESA

N88-26027# Norges Tekniske Hoegskole, Trondheim. Div. of Medical Technology.

SIMILARITIES BETWEEN DIVING OPERATIONS AND SPACE MISSIONS **c54**

Greta Bolstad *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 91-94 (For primary document see N88-26016 19-51)

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Similarities and commonalities between saturation diving and space missions, based on experience from diving and limited to human factors engineering are reviewed. Areas where European diving and space research institutions and industry may contribute to or benefit from each others experience and knowhow by working closer together are suggested. ESA

N88-26028# Service de Sante des Armees, Dijon (France).

SELECTION OF ISOLATED SPACE CREWS [SELECTION DES PERSONNELS ISOLES DE L'ESPACE] **c53**

E. Leighton *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 95-98 In FRENCH (For primary document see N88-26016 19-51)

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Experience of missions in isolated stations, of space candidate selection procedures, and in selecting flight personnel is combined to suggest a profile for space crew members and to derive selection criteria and tools. Qualities required for long duration space flight are reviewed. ESA

N88-26029# Direction des Constructions et Armes Navales, Toulon (France). Centre d'Etudes et de Recherche Techniques Sous-Marines.

CONTRIBUTION OF ULTRASONIC DOPPLER DETECTION OF CIRCULATING BUBBLES TO HUMAN INTERVENTIONS UNDER THE SEA AND IN SPACE [APPORT DE LA DETECTION ULTRASONORE PAR EFFET DOPPLER DES BULLES CIRCULANTES AUX INTERVENTIONS HUMAINES EN MER ET DANS L'ESPACE] **c52**

Gerard Masurel, R. Guillerm, and L. Giacomoni *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 99-102 In FRENCH (For primary document see N88-26016 19-51)

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The effect of hypo and hyperbaric pressure on the formation of bubbles in the blood was studied using Doppler ultrasonic detection. Study of bubble initiation enables the optimization of decompression procedures for deep sea divers and spacemen after extravehicular activity. Results obtained on human and animal subjects in underwater and high altitude tests are shown. ESA

N88-26030# Institut Francais de Recherche pour l'Exploitation de la Mer, La Seyne sur Mer.

DIFFERENT TECHNIQUES FOR INTERVENING UNDER THE SEA: POSSIBLE LINKS WITH SPACE APPLICATIONS [LES DIFFERENTES TECHNIQUES D'INTERVENTION SOUS LA MER - LEURS LIENS POSSIBLES AVEC LE DOMAINE SPATIAL] **c54**

B. Grandvaux *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 109-113 In FRENCH (For primary document see N88-26016 19-51)

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Diving techniques ranging from those using no equipment to sophisticated underwater habitats, vehicles, and robots are reviewed. Operations conducted underwater, including observations and manipulations by men and machines are outlined. Similarities with the space environment are considered, and the possibility of transferring knowhow and technology is discussed. ESA

N88-26031# Methodist Hospital, Indianapolis, Ind. Research and Development Dept.

THE US SPACE PROGRAMME SPACEWALK/EXTRAVEHICULAR ACTIVITY EXPERIENCE: PAST, PRESENT AND FUTURE **c12**

Thomas P. Moore *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 115-120 (For primary document see N88-26016 19-51)

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The history and prospects of extravehicular activity (EVA) in NASA space programs are reviewed. The first EVA in the United States program took place on Gemini 4 in 1965. Lunar exploration was accomplished by 14 two-crewmember EVAs during the Apollo program which began in 1968. The United States' only long duration space flight experience took place in 1973 to 1974 aboard Skylab, with 10 EVAs being performed. Since the beginning of the Space Shuttle program in 1981, there have been 13 two-crewmember EVAs. Space Station is planned for component construction during EVAs for initial operation during the mid 1990s. Physiological effects on crews, particularly metabolic rate, are mentioned. ESA

N88-26032# Institut Francais de Recherche pour l'Exploitation de la Mer, La Seyne sur Mer.

ERGONOMY AND INTERIOR FURNISHING OF THE CABINS OF DEEP DIVING MANNED SUBMARINES: THE NAUTILE EXAMPLE [ERGONOMIE ET AMENAGEMENTS INTERIEURS DES HABITACLES DES SOUS-MARINS HABITES GRANDE PROFONDEUR. EXAMPLE: LE NAUTILE] **c54**

J. F. Drogou, L. Giacomoni, and Eugene Radziszewski *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 121-123 In FRENCH (For primary document see N88-26016 19-51)

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Human factors engineering considerations in the design of the interior of a research submarine for great depths, particularly posture of the pilot at his workstation, are discussed. The pilot lies on a couch during the three types of task he accomplishes: steering the craft through the water, guiding it along the sea bed and instrument observation, and direct intervention using remote manipulators. A couch with joints at three places was derived: cervico-cephalic, thoraco-abdominal (hip level), and leg-thigh (knee level). Stresses induced by the working position were analyzed by measuring heart rate, breathing difficulty, and local blood circulation. Results show that heart rate increases by 10%, which is no more than normally found when going from a laying to a sitting position; slight but acceptable breathing difficulty; no circulation problems; no uncomfortable or painful situations, but a need to change position frequently. ESA

N88-26033# Bell and Trotti, Inc., Houston, Tex.

HABITABILITY OF THE SPACE STATION: FROM VEHICLE TO LIVING SPACE [HABITABILITE DE LA STATION SPATIALE. DU VEHICULE AU LIEU DE VIE] **c54**

Francis Winisdoerffer *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 125-134 In FRENCH (For primary document see N88-26016 19-51)

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Constraints, design rules, and requirements influencing the interior design of the Space Station inhabited module are reviewed. Main constraints on the envelope are the dimensions of the shuttle cargo bay and gravitational effects at the different flight phases. The interior is based on the four standoff configuration, consisting of a free space inside a tube formed by four standard double racks. The manned module has a galley, a central area for meals, teleconferences, and recreation equipped with tables, medical unit, hygiene equipment, command post, and individual cabins. Orientation in microgravity is helped by the choice of lighting and

colors, which mimic patterns found on Earth, i.e., darker colors towards the floor. Human factors which must be allowed for include noise, eating (habits and taste), smells, exercice, and free time (passive recreations such as reading or looking at the Earth are favored by crews). ESA

N88-26034# Compagnie Maritime d'Expertises, Marseille (France).
THE SAGA HIGHLY AUTONOMOUS ASSISTANCE SUBMARINE [SAGA: SOUS-MARIN D'ASSISTANCE A GRANDE AUTONOMIE] **c54**
Jean Mollard and B. Grandvaux (Institut Francais de Recherche pour l'Exploitation de la Mer, La Seyne sur Mer.) *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 135-138 In FRENCH (For primary document see N88-26016 19-51)
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A 28 m, 550 T industrial submarine was built for diver support. It consists of a pressurized cabin for six crewmembers plus a hyperbaric habitat for 4 to 6 divers capable of leaving the craft to work on sites up to 460 m depth, connected by umbilical cords. Underwater range is 150 nautical miles, and the submarine can return to its base without surfacing, for missions of over a week. Maximum depth is 600 m. The submarine can support diving in any weather conditions, even under ice. Cruising speed is 4 kts for 300 nautical miles. Energy is produced by a Stirling engine. Oxygen is stored at cyrogenic temperatures and gas is stored at 400 bar in bottles. A high degree of computerization of command and control functions allows crew numbers to be reduced. ESA

N88-26035# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. for Aerospace Medicine.
DECOMPRESSION PROCEDURES AND ACCIDENTS IN SPACE AND SEA **c52**
Juergen Wenzel and L. Vogt *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 139-147 (For primary document see N88-26016 19-51)
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The physiology and chemistry of breathing under normal terrestrial conditions and under the abnormal conditions encountered in diving underwater and in space extravehicular activity are reviewed. Decompression procedures used to prevent bubbles forming in the blood are summarized. Treatments for decompression sickness are indicated. ESA

N88-26036# Norges Tekniske Hoegskole, Trondheim. Div. of Medical Technology.
MONITORING OF DIVERS/ASTRONAUTS DURING MISSIONS **c54**
Bard Holand and Greta Bolstad *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 149-153 (For primary document see N88-26016 19-51)
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It is shown how operational monitoring of divers during deep dive missions is based on experience from onshore simulated dives. Based on extensive monitoring during simulated dives, correlations between human responses and equipment performance are recorded and used to eliminate the need for physiological monitoring during operational dives. Similarities between the requirements for operational monitoring of divers and astronauts are described. ESA

N88-26037# GKSS-Forschungszentrum Geesthacht (West Germany).
SAFETY ASPECTS IN DESIGN AND OPERATION PRACTICE OF GKSS UNDERWATER SIMULATION PLANT GUSI **c09**
Juergen Goedecken, L. Goehr, and Klaus Schmidt *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 155-159 (For primary document see N88-26016 19-51)
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Safety factors in an underwater simulation plant GUSI consisting of a deep diving system for manned dives down to a simulated water depth of 600 m, pressure chambers for diverless orientation tests down to 2000 m, and a test pool for shallow water tests are described. The facilities enable the simulation of underwater conditions with respect to pressure, temperature, water current, salinity, visibility, and contamination. Experience from oepration of safety related equipment such as life support, welding gas absorption, gas analysis, and communication is discussed. ESA

N88-26038# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
SAFETY OF EXTRAVEHICULAR SPACE ACTIVITIES [SECURITE DES ACTIVITES SPATIALES EXTRA-VEHICULAIRES] **c54**
Jacques Laloe *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 161-168 In FRENCH (For primary document see N88-26016 19-51)
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Factors which influence safety in space missions requiring extravehicular activity (EVA) are recalled. Research and development in EVA techniques are discussed. Life support systems; movement, mobility, and dexterity; interfaces; and crew procedures are considered. ESA

N88-26039# Southern California Inst. of Architecture, Santa Monica. Space Projects Group.
RECENT RESEARCH ON CREW WARDROOM HABITABILITY FOR THE SPACE STATION **c54**
D. Nixon, Regis Fauquet, and T. Taylor *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 169-173 (For primary document see N88-26016 19-51)
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The design of the crew Wardroom for the U.S./International Space Station, required to support a maximum eight-person Space Station crew for periods as long as 6 months is discussed. Research techniques involve the construction and evaluation of a simulated Wardroom with meeting, meal, galley, exercise, and workstation facilities. The research shows that much opportunity exists to improve the design of crew accommodation and facilities beyond the standards accepted or specified for initial Space Station application. Successive future Space Station crews can benefit by greater attention to good facilities and equipment design. The introduction of appropriate innovative architectural and industrial design features can help to achieve and sustain optimum operational efficiency and enhanced environmental habitability throughout the Space Station life-cycle. ESA

N88-26040# Institut Francais de Recherche pour l'Exploitation de la Mer, La Seyne sur Mer.
UNDERWATER SIMULATION FOR SPACE TELEOPERATION **c54**
J.-L. Michel and J.-F. Drogou *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 175-176 (For primary document see N88-26016 19-51)
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The use of water to simulate on land the conditions of microgravity encountered in space is reviewed. Neutral buoyancy is achieved underwater on submersibles and remotely operated vehicles but space simulation imposes specifically that the neutral buoyancy has also to be realized particularly on movable parts as telemanipulators. The physical properties of water limits the validity of the simulation to movements with very extremely low speed. Two vehicles realized for NASA are used to simulate vehicle mobility in docking phase and assembling teleoperations in water tanks. Knowing limitations and constraints, simulation in water offers the possibility to evaluate the relative efficiency of operations involving man and teleoperation on complex tasks. ESA

N88-26041# Norwegian Marine Technology Research Inst., Trondheim.
MARINTEK'S OCEAN BASIN, A TRAINING FACILITY FOR EXTRAVEHICULAR ACTIVITY? **c54**
Tor Einer Berg *In* ESA, Proceedings of the Colloquium on

Space and Sea Mar. 1988 p 177-182 (For primary document see N88-26016 19-51)
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Equipment and functional requirements for a neutral buoyancy facility for weightlessness simulation are discussed. Time schedule and costs related to modification and upgrading of an ocean basin to become an extravehicular activity training facility for ESA are estimated. ESA

N88-26042# Bureau Veritas, Courbevoie (France).
REDUCING RISKS INHERENT IN OPERATING UNDERWATER CRAFT: THE CONTRIBUTION OF CLASSIFICATION, THE EXAMPLE OF THE SAGA HIGHLY AUTONOMOUS SUPPORT SUBMARINE [REDUIRE LES RISQUES INHERENTS A L'OPERATION DES ENGINS SOUS-MARINS: L'APPORT DE LA CLASSIFICATION, L'EXEMPLE DU SAGA] **c54**
D. Berdin *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 183-189 In FRENCH (For primary document see N88-26016 19-51)
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Risks which submarines encounter during operation are reviewed. The importance of the classification attributed by organizations such as the Bureau Veritas to submarines is stressed. Regulations which such bodies impose to reduce risks are discussed. Risk analyses and the risk reduction strategy employed in the SAGA industrial submarine are described. ESA

N88-26043# CGR MeV, Buc (France).
SPACE AND SEA: IS THERE A PLACE FOR IONIZATION? [ESPACE ET MER: L'IONISATION AURA-T-ELLE SA PLACE?] **c54**
T. Sadat and C. Cuillandre *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 191-192 In FRENCH (For primary document see N88-26016 19-51)
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The ionization of food products for use by divers and space crews is suggested. The ionization of urban wastes discharged into the sea is suggested. The use of ionization in desalinization of sea water is proposed. ESA

N88-26044# Centre National d'Etudes Spatiales, Toulouse (France).
TASKS FORESEEN FOR SPACE ROBOTS AND AN EXAMPLE OF AN ASSOCIATED ORBITAL INFRASTRUCTURE [TACHES ENVISAGEES POUR LES ROBOTS SPATIAUX ET EXEMPLE D'INFRASTRUCTURE ORBITAL ASSOCIEE] **c54**
Pierre Dutto *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 199-208 In FRENCH (For primary document see N88-26016 19-51)
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Robot activities on manned space stations are discussed and permanent installation of robots on automatic space platforms is considered. Robot interventions in dangerous areas such as spaceborne nuclear reactors and platforms subjected to high doses of radiation are treated. Robots on deep space probes are assessed. The actual and envisaged orbital infrastructures of the NASA, USSR, and European space programs are reviewed. ESA

N88-26045# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
MAN VERSUS MACHINE: THE ROLE OF ASTRONAUTS IN EXTRAVEHICULAR ACTIVITY **c54**
E. Olier *In its* Proceedings of the Colloquium on Space and Sea Mar. 1988 p 213-218 (For primary document see N88-26016 19-51)
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Extravehicular acitivity (EVA) in NASA and USSR space programs is reviewed and European needs, particularly for the Columbus and Hermes programs, are assessed. It is suggested that remote manipulators and EVA are complementary, although EVA offers advantages once the work site is reached. ESA

N88-26046# MATRA Espace, Paris-Velizy (France).
COMPUTER AIDED REMOTE CONTROL: A GENERAL CONCEPT FOR INTERVENTION IN THE NUCLEAR, UNDERWATER, AND SPACE DOMAINS [TAO: TELEOPERATION ASSISTEE PAR ORDINATEUR. UN CONCEPT GENERIQUE POUR L'INTERVENTION EN MILIEU NUCLEAIRE, SOUS-MARIN OU SPATIAL] **c54**
Guy Andre and Raymond Fournier (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France) *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 221-231 In FRENCH (For primary document see N88-26016 19-51)
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Research and development in remote operation robotics are reviewed, especially flexibility, adaptability, autonomy, and system observability. An architecture for computer aided remote operation is presented. Problems associated with the main subsystems are considered: generalized bilateral control; information feedback; programming; and supervision. An integrated test site and ergonomic factors in its design are described. Applications to space, oceanographic, and nuclear domains are suggested. ESA

N88-26047# Ifremer, Paris (France).
MARINE TECHNIQUES: R AND D AXES, IDENTIFICATION OF AREAS OF COMMON INTEREST WITH SPACE TECHNIQUES [TECHNIQUES MARINES: AXES DE R ET D. IDENTIFICATION DE DOMAINES D'INTERET COMMUN AVEC LES TECHNIQUES SPATIALES] **c54**
Fabrice Theobald *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 233-234 In FRENCH (For primary document see N88-26016 19-51)
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The evolution of space and underwater technologies is reviewed and areas of cooperation are identified. These include positioning in three dimensions, remote manipulation, life in a confined space, mapping, systems reliability, and test and qualification procedures. ESA

N88-26048# Institut Francais de Recherche pour l'Exploitation de la Mer, La Seyne sur Mer.
ELIT: AN AUTONOMOUS UNDERWATER OBSERVATION ROBOT [ELIT: UN ROBOT SOUS-MARIN D'OBSERVATION AUTONOME] **c54**
P. Borot and L. Brisset *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 235-241 In FRENCH (For primary document see N88-26016 19-51)
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The ELIT manned submersible for dives down to 1000 m is introduced. The ELIT is controlled from the surface without an umbilical cord, using acoustics. Design constraints on the control system induced by the low bit rates and considerable delays inherent in acoustic transmission underwater are discussed. The onboard systems derived to overcome these problems are described. The guidance, picture transmission, and measuring systems are outlined. The craft is designed for dives lasting 3 to 4 hr in a 0.5 m/sec current, with a maximum speed of 1 m/sec. ESA

N88-26049# Societe Generale de Construction Electriques et Mechaniques Alsthom, Nantes (France). Etablissement ACB Energie.
UNDERWATER ROBOTICS IN THE SERVICE OF OIL FIELD EXPLOITATION: THE RUNNING AND INTERCONNECTING TOOL (RIT) IN THE EAST FRIGG FIELD (NORTH SEA) [LA ROBOTIQUE SOUS-MARINE AU SERVICE DE L'EXPLOITATION PETROLIERE: L'ENGIN RIT SUR LE CHAMP DE FRIGG-EST] **c54**
J. Chereau *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 243-246 In FRENCH (For primary document see N88-26016 19-51)
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The Running and Interconnecting Tool (RIT) was developed for the installation of modules of an underwater gas production station without using divers. The RIT consists of a module

maintenance structure; a crane for maintenance of the multiconnectors and protective coverings; a video system; an electrohydraulic umbilical line; a control cabin and hydraulics cabin on the surface; and an electrohydraulic control system. The RIT is designed to operate during the entire 14 yr life of the field, for 15 day periods 2 or 3 times a year. ESA

N88-26050# Institut Francais de Recherche pour l'Exploitation de la Mer, Brest (France). Dept. Qualite Essais.
MATERIALS QUALIFICATION IN OCEANOLOGY AND THE OFFSHORE INDUSTRY [QUALIFICATION DES MATERIELS EN OCEANOLOGIE ET INDUSTRIE OFFSHORE] **c39**
Jean-Francois Couchouron *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 247-250 In FRENCH (For primary document see N88-26016 19-51)
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A method for qualifying materials for marine applications is outlined and a guide to the method is summarized. A test program is drawn up by first considering the service profile of the material, defining the attacks from the environment it is subjected to in each situation identified in the profile, and then deriving the severity of test required. ESA

N88-26051# Institut Francais de Recherche pour l'Exploitation de la Mer, Brest (France).
UNDERWATER OPTICAL TRAJECTOGRAPHY AND VIDEO IMAGE MOSAICS [TRAJECTOGRAPHIE OPTIQUE SOUS-MARINE ET MOSAIQUES D'IMAGES VIDEO] **c74**
J.-M. Augustin, J. M. Boucher, P. Bouthemy, J.-P. Hue, and G. Loaec *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 251-255 In FRENCH (For primary document see N88-26016 19-51)
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The feasibility of a system to derive the trajectory of a craft by analyzing video image sequences was studied. The proposed method detects tracers automatically and estimates the movement of the craft by following the tracers in the sequence. A non real time video image processing program was developed. The program consists of a number of programs to choose the images, digitize them, enhance contrast, and create mosaics. The trajectory of the craft must be known. The method can be adapted to aerial photography and acoustic cameras. ESA

N88-26052# Aeroformation Blagnac (France).
DEVELOPMENT OF TRAINING IMPLYING MAN-MACHINE INTERFACE: FROM THE AIRCRAFT TO THE SPACECRAFT [DEVELOPPEMENT DE FORMATION IMPLIQUANT L'INTERFACE HOMME-MACHINE: DE L'AVION AU VAISSEAU SPATIAL] **c54**
Jean-Francois Schmidt *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 257-259 In FRENCH (For primary document see N88-26016 19-51)
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Developments in crew training for aircraft are reviewed and the contribution of audiovisual training aids such as flight simulators is shown. The need for improved training, involving computers, to help crews cope with integrated control systems and the introduction of expert systems is stressed. Applicability of these techniques to space and underwater domains is possible. ESA

N88-26053# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
OVERVIEW OF SPACE MISSIONS AND TECHNIQUES FOR OCEAN MONITORING **c43**
N. deVilliers *In its* Proceedings of the Colloquium on Space and Sea Mar. 1988 p 265-272 (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

Past, present, and future space missions contributing to the monitoring of ocean phenomena for scientific and operational applications are reviewed. The merits of satellite techniques are discussed and the major classes of sensors used for oceanographic applications are presented together with their measurement performances. Aspects related to orbits, data acquisition, processing, and dissemination are also covered. ESA

N88-26054# International Maritime Satellite Organization, London (England).
SATELLITES AT SEA **c32**
Keith Thacker *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 273-279 (For primary document see N88-26016 19-51)
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The International Maritime Satellite (INMARSAT) organization, equipment, and services are presented. Essential components of the INMARSAT system are: the space segment, the satellites and ground support facilities planned, procured and maintained by INMARSAT and funded by its Signatories; the Coast Earth Stations (CES) which provide an interface between the space segment and the national and international fixed telecommunications networks and which are funded, generally, by Signatories; and the Ship Earth Stations, the satellite communications terminals which are purchased or leased by individual owners/operators. Communications from the CES to satellite are in the 6 GHz band (C-band) and from the satellite to the CES are in the 4 GHz band. The links between the satellite and user are at L-band; 1.5 GHz from satellite to user and 1.6 GHz from user to satellite. ESA

N88-26055# International Chamber of Shipping, London (England).
THE CONTRIBUTION OF SPACE TO MARITIME ACTIVITIES **c43**
M. A. Calder *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 281-286 (For primary document see N88-26016 19-51)
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The contribution of space to maritime activities, where the space vehicle itself provides a maritime function or where space provides the relay of communications is reviewed. The need for monitoring the meteorological and hydrographic maritime environment increases in order to safeguard sophisticated but more vulnerable ships. Equally important is to know their position accurately and, in a casualty to provide effective communications to locate and rescue of survivors. Space demonstrates its ability to provide quality telecommunications to shipping for all these purposes. ESA

N88-26056# Centre National d'Etudes Spatiales, Toulouse (France).
SENSORS IN SPACEBORNE OCEANOGRAPHY [LES CAPTEURS EN OCEANOGRAPHIE SPATIALE] **c43**
M. Avignon and M. Dorrer *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 287-296 In FRENCH (For primary document see N88-26016 19-51)
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Passive spaceborne oceanographic sensors; optical radiometers; infrared and microwave devices; active sensors; side looking radar and altimeters; positioning systems; and data acquisition systems are reviewed. Orbital considerations in spaceborne oceanography are mentioned. ESA

N88-26057# Direction de la Meteorologie Nationale, Paris (France).
CONTRIBUTION OF SPACE TO MARINE ACTIVITIES [APPORT DE L'ESPACE AUX ACTIVITES MARITIMES] **c43**
Francois Gerard *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 299-303 In FRENCH (For primary document see N88-26016 19-51)
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The use of meteorological data from satellites in ship routine and of remote sensing data to help fishing is reviewed. Opportunities for ERS-1 to expand products available to maritime users of remote sensing data are mentioned. ESA

N88-26058# Centre National d'Etudes Spatiales, Toulouse (France).
THE FRENCH SPACEBORNE OCEANOGRAPHY PROGRAM [LE PROGRAMME FRANCAIS D'OCEANOGRAPHIE SPATIALE] **c48**
Jean-Louis Fellous and B. Voituriez (Ifremer, Paris, France) *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 305-310 In FRENCH (For primary document see N88-26016 19-51)
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The French space oceanography program is aimed at improving knowledge and understanding of the oceans and of their role in climate and climate change, through the development and use of space techniques. Another objective is to prepare for potential applications of ocean observations from space. The program encompasses the various fields of ocean research and involves a series of flight instruments and dedicated satellite missions. Techniques to be used include altimetry, scatterometry, visible, infrared and microwave radiometry, precise tracking (DORIS) as well as data collection and localization systems (ARGOS). An important effort is devoted to ocean data archiving and processing (projects CERSAT and AVISO). Eight major French research institutions coordinate their activities in space oceanography in the framework of GREOS. The whole program is largely based on international cooperation and is closely related to the world research programs on climate (WCRP) and the ocean (TOGA, WOCE, GOFS). Projects under development include TOPEX/POSEIDON, a dedicated altimetric satellite mission; ATSR/M, a passive microwave radiometer for ERS-1; and Vegetation, a large swath medium resolution radiometer to be flown onboard the SPOT 4 satellite. ESA

N88-26059# Institut Francais de Recherche pour l'Exploitation de la Mer, Brest (France).
THE CERSAT ARCHIVING AND PROCESSING CENTER [LE CENTRE ERS POUR L'ARCHIVAGE ET LE TRAITEMENT (CERSAT)] **c82**
Patrick Farcy and A. Cavanie *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 311-316 In FRENCH (For primary document see N88-26016 19-51)
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The center for the reception, control, archiving processing, and dissemination of ERS-1 low bit rate data from the radars, wind scatterometer, altimeter, and wave scatterometer is presented. Main users are scientists involved in oceanography, and clients needing ocean and climate data such as the offshore industry, navigation, coastal management. Extension of the services offered to include the TOPEX POSEIDON, NROSS and similar programs is envisaged. ESA

N88-26060# Alcatel Thomson Espace, Toulouse (France).
DETERMINATION OF THE OCEAN CIRCULATION BY SPACEBORNE RADAR ALTIMETER **c48**
Pierre deChateau-Thierry *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 317-321 (For primary document see N88-26016 19-51)
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The TOPEX/POSEIDON joint mission of the NASA experiment TOPEX (Ocean Topography Experiment) and the French POSEIDON program is introduced. The purpose of the mission is the accurate measurement of the sea surface to assess ocean currents in order to improve knowledge of ocean circulation and its variability in mesoscale. The POSEIDON radar altimeter is a design mixing the advantage of the SEASAT architecture, the potential of advanced technology, and the knowledge of operational requirements that comes from SEASAT results. It is a single-frequency radar altimeter operating at a pulse repetition frequency of 1700 Hz. The center frequency is 13.65 GHz, bandwidth 320 MHz, and pulse duration 100 microsec. Samples are produced by the FFT-SA at a rate of 10 KHz which, in turn, defines the length of the short, or compression pulse (the interval between samples produced at a rate of 10 KHz is 10/3.2 ns or 3.125 ns). The pulse compression ratio is 320 MHz/10 KHz or 100 microsec/3.125 ns, i.e., 32,000:1. The radiated power rating is 5 W while the gain of the 1.2 m diameter antenna is estimated at 42 dB. The echo generator test bench is described. ESA

N88-26061# Bureau Veritas, Courbevoie (France).
OCEAN SATELLITE DATA AND THE NEEDS OF DESIGNERS AND OPERATORS OF MARINE UNITS **c48**
Michel Huther and R. Nerzic (Elf Aquitaine, Pau, France) *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 323-325 In FRENCH; ENGLISH summary (For primary document see N88-26016 19-51)
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Satellite programs oriented to the study of oceans, in particular the European program of ERS-1 are reviewed. The projected studies are mainly scientific, to obtain a better knowledge of parameters defining environment. Among the defined measurements, parameters are of interest for professionals working on marine subjects, particularly wind and waves. The designers and operators of marine units, such as offshore platforms and ships, are users of data on sea states and environmental conditions. The data are necessary during the various phases of a project, site evaluation, strength calculations, and operation surveys. For the ERS-1 project an altimeter to provide data on the wave profile along the satellite track, i.e., in one direction only, and a SAR imaging radar which provides a wide view of the sea surface are planned. ESA

N88-26062# MATRA Espace, Paris-Velizy (France).
BATHYMETRY ESTIMATION BY ANALYZING SWELL ON SPOT IMAGES [ESTIMATION DE LA BATHYMETRIE PAR ANALYSE DE LA HOULE SUR IMAGE SPOT] **c48**
Yves Rabu, G. Ruckenbusch, and F. Barbereau *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 327-332 In FRENCH (For primary document see N88-26016 19-51)
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Bathymetry was obtained by inversion of a refraction model of swell by analyzing sea surface state in SPOT images. Sea surface state is modeled as a plane sine function with slowly varying spatial frequencies. A map of the wavelength and propagation direction of the swell is derived by estimating the spatial frequencies with the maximum likelihood method on a sliding window. This is the same as looking for the maximum of the two-dimensional period diagram of the sample (squared module of the Fourier transformation). Errors for the measure obtained are less than 10% for depths less than half the wavelength of the waves. ESA

N88-26063# Centre National de la Recherche Scientifique, Paris (France).
CONTRIBUTION OF SPACEBORNE HIGH RESOLUTION RADIOMETERS TO MAPPING OF PRECOASTAL DEPTHS [APPORTS RADIOMETRES A HAUTE RESOLUTION SPATIALE POUR LA CARTOGRAPHIE DES HAUTS FONDS PRE LITTORAUX] **c43**
A. T. Diaw, E. Guillemot, L. Menanteau, Y.-F. Thomas, R. Zbinden, and C. A. A. Amaya *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 333-338 In FRENCH (For primary document see N88-26016 19-51)
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High resolution radiometric imagert from the SPOT HRV instrument of the Atlantic coast off the Saloum (Senegal) tidal delta and of the Rosario Archipelego (Columbia) was analyzed. Bathymetric and turbidity maps of the areas are presented. The usefulness of the SPOT images in revealing reef structures and in explaining the morphodynamic evolution of the sediment structures which hinder navigation in the mouth of the Saloum is shown. ESA

N88-26064# Observatoire de Paris-Meudon (France).
STUDY OF THE ARACHON (FRANCE) UNDERWATER DELTA USING THEMATIC MAPPER DATA [ETUDE DU DELTA SOUS-MARIN D'ARCACHON D'APRES DES DONNEES DU THEMATIC MAPPER] **c43**
Dong Chen He, J. LeRhun, and Li Wang *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 339-343 In FRENCH; ENGLISH summary (For primary document see N88-26016 19-51)
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The passes of the Arcachon Basin (France) which are affected by unpredictable spatial instabilities were analyzed. Using the dynamic-cluster algorithm, the site was studied with a classification of a LANDSAT-5 TM image acquired 2 h 20 min after high tide. The classification result shows clearly the exterior contour of the submarine delta. The south channel, where the flood predominates, and the north channel, where the ebb predominates, are well characterized. The cross-channel appears shallow and not very marked. Although underwater, the sandy banks are well seen in the classification map. This cartography shows that satellite data are a precious tool for dynamic studies of the littoral and submarine sedimentations. ESA

N88-26065# Ecole Nationale Superieure des Mines, Valbonne (France).
IMAGE PROCESSING APPLIED TO QUANTITATIVE NUMERICAL CARTOGRAPHY OF OCEAN CIRCULATION [TRAITEMENT D'IMAGES APPLIQUE A LA CARTOGRAPHIE NUMERIQUE QUANTITATIVE DE LA CIRCULATION OCEANIQUE] **c48**
B. Bianchi and L. Wald *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 345-347 In FRENCH (For primary document see N88-26016 19-51)
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A numerical method for calculating ocean surface currents is presented. It uses a pair of satellite thermographs, which are employed to solve an unsteady advection equation of the heat in each pixel of the image. Application to a vortex in the Gulf Stream show the usefulness of the method. ESA

N88-26066# Ecole Nationale Superieure des Mines, Valbonne (France).
METHODS FOR PROCESSING SATELLITE IMAGES AND THEIR APPLICATION TO UNDERWATER OPERATIONS [LES METHODES DE TRAITEMENT D'IMAGES SATELLITAIRES ET LEUR APPLICATION AUX TRAVAUX SOUS-MARINS] **c48**
L. Wald *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 349-351 In FRENCH (For primary document see N88-26016 19-51)
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The principals of digital processing of Earth observation satellite images of the ocean are recalled. The similarity between problems encountered in this domain and the processing of underwater images is pointed out. The application of space image processing techniques to underwater imagery is discussed. ESA

N88-26067# Wisconsin Univ., Madison.
PHOTOCHROME FROM GREEN PLANTS: ASSAY, PURIFICATION AND CHARACTERIZATION
P. H. Quail 1 Mar. 1988 18 p
(Contract DE-AC02-81ER-10903)
(DE88-007511; DOE/ER-10903/8) Avail: NTIS HC A03/MF A01

This research has been directed toward characterizing and purifying the molecular species of phytochrome detected in green Avena tissue. We have found major differences between the phytochrome extracted from green and from etiolated tissue as regards immunochemial and spectral properties. In addition, we have established: (a) that the predominant phytochrome polypeptide in green tissue has a relative molecular mass (Mr) of 118,000;(b) that the proteolytic peptide map of this 118,000-Mr species differs considerably from that of 124,000-Mr phytochrome from etiolated tissue;(c) that the green-tissue, 118,000-Mr polypeptide carries only one of three spatially separate epitopes that are present on etiolated-tissue phytochrome; (d) that the minor phytochrome species in green tissue resembles that in etiolated tissue in that it is 124,000-Mr and is immunoprecipitable with polyclonal, anti-etiolated-oat-phytochrome antibodies, thereby accounting for the previously observed limited population of immunoprecipitable activity in green extracts; and (e) that the 118,000-Mr green-tissue molecule migrates on non-denaturing size exclusionchromatography as a approximately 320 kDa entity, suggesting a quaternary structure similar to etiolated tissue 124,000-Mr phytochrome. DOE

N88-26068# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
EMBRYONIC DEVELOPMENT OF THE NEWT CYNOPS PYRRHOGASTER IN VERY WEAK MAGNETIC FIELDS
Makoto Asashima, Yoshihiro Mogami, Makoto Okuno, and Shoji A. Baba Jan. 1987 16 p
(ISAS-RN-357) Avail: NTIS HC A03/MF A01

Whether embryogenesis of the newt, Cynops pyrrhogaster is affected by very weak magnetic fields was studied, using a large magnetic shielded room designed for the purpose of evaluation of magnetic characteristics of spacecraft and for other work in the Institute of Space and Astronautical Science. Newt adults, injected with gonadotropins a few days before and therefore ready to deliver eggs, fertilized eggs, and embryos of various developmental stages were left at 5-7 nT in the magnetic shielded room for up to several days. Embryos of most stages developed normally until at least 15 days later as did those of control experiments in the earth magnetic fields around the shielded room. As compared with control embryos, however, a higher percentage of embryos from eggs produced by the adults in the shielded room and of embryos placed there at stages from gastrula through neurula had delayed or arrested development and died within a few days. This fact suggests that embryos of very early stages including ovulation and fertilization and of the gastrula-neurula stage are sensitive to exposure to very weak magnetic fields. Author

N88-26069# Joint Publications Research Service, Arlington, Va.
JPRS REPORT: SCIENCE AND TECHNOLOGY. USSR: SPACE BIOLOGY AND AEROSPACE MEDICINE, VOLUME 22, NO. 1, JANUARY - FEBRUARY 1988
O. G. Gazenko, ed. 23 Jun. 1988 153 p Transl. into ENGLISH of Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 22, no. 1, Jan. - Feb. 1988 96 p
(JPRS-USB-88-005) Copyright Avail: NTIS HC A08/MF A01

Articles are translated and presented from a Russian bimonthly journal entitled Space Biology and Aerospace Medicine. Representative titles from this journal are: Human hemodynamics during water immersion as related to position; Analysis of clinical symptoms of human decompression sickness; Growth and differentiation of cells in organotypical rat embryo cerebellar culture developing in weightlessness; Macaca Rhesus tolerance to +Gz accelerations; Effect of long term inhalation of acetic acid vapor on some functional parameters of man; Cardiac rhythm of animals consuming reclaimed water differing in concentration of sodium and potassium; and Biological patterns of growth in postnatal ontogenesis of lower primates. For individual titles, see N88-26070 through N88-26095.

N88-26070# Joint Publications Research Service, Arlington, Va.
RESULTS OF MEDICAL RESEARCH CONDUCTED IN 1985 DURING LONG-TERM SPACEFLIGHTS **c52**
A. D. Yegorov, O. D. Anashkin, O. G. Itsekhovskiy, I. V. Alferova, Z. A. Golubchikova, V. R. Lyamin, A. P. Polyakova, V. F. Turchaninova, V. A. Talavrinov, and V. D. Turbasov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 1-4 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 4-7 (For primary document see N88-26069 19-51)
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Medical results obtained during the fourth expedition of five cosmonauts onboard orbital complexes Salyut T - Soyuz T-13 and Salyut 7 - Soyuz T-14 are presented. The cardiovascular system was examined using 36 resting and provocative tests. They were performed by means of electrocardiography, tetrapolar rheography, arteriovenous pulsography and tachooscillography. In addition, body mass and leg volume were measured. The above parameters showed typical variations as well as individual changes related to the preflight circulation level and environmental effects. The use of modified regimens of provocative tests demonstrated their applicability to the assessment of cardiovascular function in space flight. Author

N88-26071# Joint Publications Research Service, Arlington, Va.
HUMAN HEMODYNAMICS DURING WATER IMMERSION AS RELATED TO POSITION DURING SUBMERSION c52
A. M. Genin, A. Yu. Modin, and V. S. Shashkov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 5-8 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 7-10 (For primary document see N88-26069 19-51)
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Central and peripheral hemodynamics were investigated in 16 essentially healthy volunteers who performed a routine tilt test or a tilt test in water immersion. Unlike tilt tests carried out before water immersion, the supine to upright transfer in water did not change cardiac rhythm, cardiac output, leg blood flow or other circulation parameters. The fact that there are no posture related circulation changes in water immersion suggests that the horizontal and upright positions in water can be viewed as hemodynamically similar. Author

N88-26072# Joint Publications Research Service, Arlington, Va.
HEMOSTASIS PARAMETERS OF INDIVIDUALS WITH NEUROCIRCULATORY DYSTONIA SUBMITTED TO DRY IMMERSION c52
L. L. Kirichenko, V. P. Masenko, A. B. Raskurazhev, and A. G. Yevdokimova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 9-12 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 10-13 (For primary document see N88-26069 19-51)
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Twelve volunteers, aged 45 to 55 years, with hypertension type neurocirculatory dystonia were exposed to 7 day dry immersion. Plasma, platelet and vessel hemostasis was investigated. Dry immersion was found to stimulate hypercoagulatory changes in the above hemostasis systems. It was also shown that the test subjects developed a slow process of readaptation. Author

N88-26073# Joint Publications Research Service, Arlington, Va.
SIGNIFICANCE OF NUTRITION TO CHANGE IN HUMAN CARBOHYDRATE AND LIPID METABOLISM UNDER EMOTIONAL STRESS c52
V. P. Bychkov, L. I. Mosyakina, and O. S. Khokhlova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 13-17 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 13-17 (For primary document see N88-26069 19-51)
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Two experiments were performed on 16 test subjects (13 men and 3 women) to study stress effects on the blood content of sugar and cholesterol. The test subjects were given a nutritionally balanced diet of canned foodstuffs. The caloric value of the diet was adequate to energy expenditures. In the first experiment, the test subjects were also given vitamin E, nicotinic acid and other vitamins constituting the polyvitamin complex Aerovit. In the second experiment, they were additionally given calcium and potassium salts, glucose and phosphatide concentrate. The stress agent was a test in the rotating chair in the first experiment and a psychologic test (mental work within a limited period of time to reach success or failure) in the second experiment. The content of sugar and cholesterol before and after the stress effects did not differ significantly. This can be attributed to the prophylactic effect of the nutritional factor on carbohydrate and lipid metabolism in an emotionally stressed man. Author

N88-26074# Joint Publications Research Service, Arlington, Va.
ANALYSIS OF CLINICAL SYMPTOMS OF HUMAN DECOMPRESSION SICKNESS DURING ALTITUDE CHAMBER STUDIES c52
L. R. Iseyev, A. S. Tsivilashvili, and V. I. Chadov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 18-22 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 17-21 (For primary document see N88-26069 19-51)
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Over 2400 altitude chamber ascents in which 130 volunteers participated were performed using different decompression tables. The cases of decompression disease were classified in terms of its types and severity. It is stressed that the experimenters involved in decompression studies have to be extremely careful because the disease may have various and sudden manifestations. Author

N88-26075# Joint Publications Research Service, Arlington, Va.
ELECTROENCEPHALOGRAPHIC CHANGES DURING EQUILIBRIUM TEST IN THE PRESENCE OF RHYTHMIC PHOTIC INTERFERENCE c52
Ye. T. Petrenko *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 23-28 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 21-25 (For primary document see N88-26069 19-51)
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Reliable diagnosis of Central Nervous System (CNS) noise resistance is important in the selection of operators and pilots. A study was performed to investigate neocortex biopotentials of 74 subjects during equilibrium tests in the presence or absence of 123 Hz light flashes. Electrical cardiographic and stabilographic recordings were taken from 6 sites of the left neocortex during equilibrium tests and during light stimulation. EEG's were processed through correlation spectral analysis by computers. During light stimulation 35 nonsusceptible subjects maintained equilibrium for as long as 80 to 100 percent of the normal time, while 39 susceptible subjects maintained it for only 10 to 30 percent. In response to light stimulation susceptible subjects showed distinct rearrangement of the autospectral and coherence functions. Certain changes in the spectral analysis were more pronounced in the neocortex areas related to movement organization, viz. premotor, motor and sensorimotor areas. In the nonsusceptible subjects light stimulation induced no changes in the EEG. It is concluded that noise resistance of the motor control system depends on the CNS capacity to prevent the rhythm of light stimulation to occur in EEG's of motor areas. Author

N88-26076# Joint Publications Research Service, Arlington, Va.
GROWTH AND DIFFERENTIATION OF CELLS IN ORGANOTYPICAL RAT EMBRYO CEREBELLAR CULTURE DEVELOPING IN WEIGHTLESSNESS
I. V. Viktorov, N. A. Shashkova, A. Privat, and M.-J. Drian *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 29-34 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 25-29 (For primary document see N88-26069

19-51)
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Cerebellar cells of 18 day rat fetuses that developed for 5 days on Cosmos 1514 and those of synchronous and vivarium controls were cultivated for 21 days in Maximov chambers. Light microscopic examinations of live explants and semithin sections revealed no disorders in histotypical structures of cells. It is concluded that space flight effects on the cerebellar morphogenesis of rat fetuses exposed to microgravity during days 13 to 18 of their prenatal development did not lead to such changes in the differentiation of nerve and glia cells which would cause morphogenetic disorders during postflight organotypical cultivation. Author

N88-26077# Joint Publications Research Service, Arlington, Va.
NONINVASIVE EXAMINATION OF BONES DURING LONG-TERM HYPOKINESIA c52

V. S. Oganov, A. S. Rakhmanov, B. V. Morukov, Kh. A. Yanson, A. M. Tatarinov, V. Ye. Zaychik, S. K. Ternovoy, and C. Cann *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 35-40 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 30-33 (For primary document see N88-26069 19-51)
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The effect of 120 day bed rest on skeletal bones of 25 volunteers was investigated by noninvasive methods, viz. gamma photon absorption, ultrasonic and neutron activation analysis. The subjects were divided into 4 groups, one of which served as control and three others used different countermeasures (drugs, exercise or drugs in combination with exercise). Calcium loss in skeletal bones was not more than 0.5 percent per month; calcium loss in leg tubular bones was 1 to 2 percent per month in 6 subjects; calcium loss in heel bones was on the average 3 to 4 percent per month in the control, exercise and combination groups. No strict correlation between the negative balance of calcium and mineral content in leg compact bones and foot spongy bones was found. There was a correlation between changes in the mineral content of leg bones and ultrasound propagation along certain compartments of the tibial median surface. In terms of negative and positive trends, leg and foot bones were in better condition in the drug group. The techniques used were assessed with respect to their diagnostic and prognostic value. Author

N88-26078# Joint Publications Research Service, Arlington, Va.
EFFECT OF DIFFERENT DOSES OF ALPHA-HYDROXYDIMETHYL-GAMMA-AMINOPROPYLIDENE BISPHOSPHONATE ON RAT BONES

V. N. Shvets *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 41-45 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 34-37 (For primary document see N88-26069 19-51)
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For 10 days rats were subcutaneously injected with alpha-hydroxydimethyl gamma aminopropylidene biphosphonate in the dose range 0.005 to 5 mg/kg/day. As shown morphometrically, the mass of spongy bone increased linearly with the dose. It was found that the drug affected primarily the highly metabolic component of spongy bone. The drug has a systemic osteotropic effect and modified the number of osteocytes significantly. When the drug was injected for a long time (up to 60 days), the number of osteoclasts decreased and the proportion of cells containing more than one nucleus remained within normal limits. The number of osteoblasts either diminished (in long bones) or remained unchanged (in torso and pelvic bones). It is concluded that the osteotrophic effect of the drug is mediated via its action on bone resorption, the rate of which is inhibited; this is responsible for bone mass growth. Author

N88-26079# Joint Publications Research Service, Arlington, Va.
ROLE OF OPIOID PEPTIDES IN PATHOGENESIS OF VESTIBULOVEGETATIVE DISORDERS

V. S. Shashkov, Yu. V. Drozd, V. V. Yasnetsov, Ye. Yu. Galkina, and Yu. I. Ryumin *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 46-50 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 37-40 (For primary document see N88-26069 19-51)
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A study was carried out using 12 noninbred male cats and 14 white rats. In response to vestibuloautonomic disorders, the rats showed a decrease of beta-endorphin in the midbrain, medulla oblongata and hypothalmus as well as a reduction of met-enkephaline in the hypothalamus and medulla oblongata. The concentration of met-enkaphaline in the adrenals increased and that of beta-endorphine in blood did not change. This may be attributed to the intraneuronal redistribution of opioids and their transfer to the pituitary or release in the cerebrospinal fluid. Opioid variations give evidence that vestibuloautonomic disorders in rats do not stimulate the pituitary adrenal system. The cats were exposed to vestibulo-autonomic disorders and subsequent intracerebroventricular administration of regulatory peptides or injection of opiate receptor blockers into the chemoreceptor trigger zone. It was demonstrated that naloxone, gamma endorphine and des-Tyr-gamma-endorphine were effective in protecting the vestibular function whereas ICI 154, 129 (a selective antagonist of delta receptors) was practically ineffective. Author

N88-26080# Joint Publications Research Service, Arlington, Va.
MACACA RHESUS TOLERANCE TO +Gz ACCELERATIONS

I. F. Vil-Vilyams, V. I. Korolkov, V. P. Krotov, A. A. Shipov, V. G. Andreyeva, L. A. Tabakova, S. F. Kholin, A. N. Truzhennikov, and Yu. V. Gordeyev *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 51-57 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 40-45 (For primary document see N88-26069 19-51)
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The procedure of selection and training of rhesus monkeys included +Gz acceleration tests. Two experimental series were performed. In the first experimental series (52 monkeys) acceleration tolerance was determined with respect to general health condition and behavioral responses of animals, electrocardiographic data (in 3 standard leads), heart rate and respiration rate. In the second experimental series, acceleration tolerance was measured on the basis of blood pressure and flow velocity in the common carotid artery. Rhesus monkeys exhibited noticeable individual variations in +Gz tolerance as well as in circulation responses to this exposure. The tests helped to select flight animals with a high level of acceleration tolerance. Author

N88-26081# Joint Publications Research Service, Arlington, Va.
EFFECT OF LOW-FREQUENCY WHOLE-BODY VERTICAL VIBRATION ON THE SEROTONINERGIC SYSTEM OF THE BRAIN AND SPINAL CORD c52

A. S. Dmitriyev and G. K. Tropnikova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 58-63 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 45-49 (For primary document see N88-26069 19-51)
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Rat experiments were performed to study variations in serotonin (5-HT) and its metabolite (5 hydroxy indole acetic acid) in different central nervous system compartments. Control animals were exposed to an acute vibration stress (10 Hz, 1 mm, 2 m/sq sec, 15 min) and experimental animals to a prolonged (52 to 54 days) vibration test. Acute vibration led to 5-HT activation which was most significant in the hippocampus, diencephalon, cerebellum and

in the sacrolumbar cord. Prolonged vibration caused an increase of 5-HT in the parietal cortex and its enhanced utilization in the striatum, diencephalon, pons and in the sacrolumbar cord. As compared to the controls, vibration produced a smaller acculumation of 5-HT in the hippocampus and a larger accumulation in the cerebellum, diencephalon, medulla oblongata and spinal cord. The role is discussed of regional changes in 5-HT metabolism and reactivity of serotoninergic structures in the mechanism of vibration related somatosensory disorders. Author

N88-26082# Joint Publications Research Service, Arlington, Va.
DISTINCTIVE FEATURES IN BLOOD CLOTTING AND FIBRINOLYTIC PROPERTIES UNDER EFFECT OF EPINEPHRINE IN PRESENCE OF HYPOXIA AND HYPERCAPNIA **c52**

G. D. Pak, V. S. Sverchkov, T. N. Danilevskaya, and T. P. Trandafilova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 64-69 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1. Jan.-Feb. 1988 p 49-53 (For primary document see N88-26069 19-51)

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Acute experiments were carried out on 50 dogs to study the effect of epinpehrine in hypoxic (N2-15 to 10 percent O2) or hypoxic-hypercapnic (N2-10 percent O2-5 percent CO2) atmospheres. Epinephrine led to a maximum increase of blood coagulation and fibrinolysis in normoxic atmosphere. Hypoxia reduced the shift of most hemostasis parameters in response to epinephrine. However, in N2-10 percent O2 atmosphere the epinephrine induced increase of blood coagulation was superimposed on initial hypoxic hypercoagulation and caused serious disorders in hemostasis. In hyperoxic-hypercapnic atmosphere, increase of blood coagulation in response to epinephrine was more than doubled when compared to that in hypoxic atmosphere, reaching control values. Nevertheless, after epinephrine administration, the ratio of coagulatory, anticoagulatory and fibrinolytic activities was more beneficial in hypoxia-hypercapnia and the coagulation potential was lower than in hypoxic or normoxic atmospheres. Author

N88-26083# Joint Publications Research Service, Arlington, Va.
HEMORRHAGES AND HEMOSTASIS IN GUINEA PIGS EXPOSED TO RADIATION AT HIGH ALTITUDE

V. N. Tartakovskiy and S. B. Daniyarov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 70-76 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 53-57 (For primary document see N88-26069 19-51)

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Hemorrhagic intensity, hemostasis and blood vessel wall resistance to mechanical effects were studied in guinea pigs exposed to whole body irradiation (3.0 Gy). The animals were irradiated at low altitude (760 m above sea level) and at high altitude (3200 m above sea level) after 1 and 31 days of adaptation. It was demonstrated that hemorrhagic intensity in both groups of guinea pigs irradiated at high altitude was significantly reduced in comparison with that in low altitude. The decrease in radiation induced hemorrhages at high altitude is associated with less severe changes in thrombopoiesis, blood vessel wall and blood coagulation. Author

N88-26084# Joint Publications Research Service, Arlington, Va.
EFFECT OF LONG-TERM INHALATION OF ACETIC ACID VAPOR ON SOME FUNCTIONAL PARAMETERS OF MAN **c52**

V. P. Savina and B. V. Anisimov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 77-82 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 57-61 (For primary document see N88-26069 19-51)

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Test subjects were continuously exposed to acetic acid vapors which form a constant component of enclosed atmospheres. The inhalation time was 15 to 22 days at concentrations of 5, 10 and 15 mg/cu m or 10 days at a concentration of 26 mg/cu m. Physiological parameters showed statistically significant changes at concentrations of 15 and 26 mg/cu m. It is suggested that the changes are not adaptive but have been produced by the adverse effect of acetic acid vapors on the human body. It is therefore concluded that the 15 mg/cu m concentration is threshold and the 5 and 10 mg/cu m concentrations are ineffective in terms of the tests used. The most sensitive method is measurement of hydrocarbons (C2 to C5), especially ethylene, in the exhaled air. Author

N88-26085# Joint Publications Research Service, Arlington, Va.
CARDIAC RHYTHM OF ANIMALS CONSUMING RECLAIMED WATER DIFFERING IN CONCENTRATION OF SODIUM AND POTASSIUM IONS

V. A. Kondratyuk and M. S. Gnatyuk *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 83-86 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 61-63 (For primary document see N88-26069 19-51)

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The effect of reclaimed potable water on cardiac rhythms of 190 noninbred white male rats was investigated in a 6 month experiment. The water contained 25.0 to 100.0 mg/l sodium and/or 2.5 to 10.0 mg/l potassium. The water containing 100 mg/l sodium and 10 mg/l potassium caused changes in both compartments of the autonomic nervous system controlling cardiac rhythms. The water containing 75.0 and 50.0 mg/l sodium and 7.5 and 5.0 mg/l potassium produced insignificant changes in cardiac rhythms. The water containing lower concentrations of sodium (25.0 mg/l) and potassium (2.5 mg/l) had no effect. Author

N88-26086# Joint Publications Research Service, Arlington, Va.
VALIDATION OF MAXIMUM PERMISSIBLE CONCENTRATION OF UREA IN RECLAIMED POTABLE WATER AND EVALUATION OF ITS BIOLOGICAL EFFECT

N. V. Mironets, R. V. Savina, I. S. Kucherov, V. V. Solntseva, and N. V. Martyshchenko *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 87-91 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 63-66 (For primary document see N88-26069 19-51)

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The study was used to identify maximum allowable concentrations of urea in reclaimed potable water. The urea concentration equal to 80 mg/l is the threshold dose influencing the taste and flavor of water. Urea is a low toxicity substance, the effect of which is not cumulative. However, when used in high doses it affects bioenergetic and cholinergi processes and causes changes in ECG, higher nervous activity and visceral structure. It was shown that when applied to warm blooded animals, the acting dose of urea is 14.3 and 1.43 mg/kg, the threshold dose is 0.72 mg/kg, and the ineffective dose is 0.36 mg/kg which amounts to the concentration of 10 mg/l. In terms of toxic effects, the dose equal to 10 mg/l is taken to be the maximally allowable concentration of urea. It is recommended to use the Laham biotest for measuring urea in water. Author

N88-26087# Joint Publications Research Service, Arlington, Va.
BIOLOGICAL PATTERNS OF GROWTH IN POSTNATAL ONTOGENESIS OF LOWER PRIMATES

Yu. N. Kurochkin and G. S. Belkaniya *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 92-98 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1,

Jan.-Feb. 1988 p 66-70 (For primary document see N88-26069 19-51)
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In 840 male rhesus monkeys relationships between age, height, weight and growth rate were examined. In terms of growth rate, the following five age periods were identified in the predefinitive stage of postnatal ontogenesis: childhood - from birth to 9 months; adolescence - from 9 month to 3 years; accelerated growth or pubescence - from 3 to 4.5 years; growth completion - from 4.5 to 7 or 8 years; and physiological maturity (definitive stage) - over 8 years. The above age periods derived from growth curves are consistent with the development of the dental system, reproductive organs and other biological signs of postnatal ontogenesis. The relationships between calender age, height and weight with respect to each age period are described by linear regression equations. The basic patterns of physical development, period of postnatal ontogenesis and somatometric characterization described above help to objectively monitor the physical fitness of rhesus monkeys, to adequately select animals identical in terms of their biological age, and to reliably plan long term studies on this primate species. Author

N88-26088# Joint Publications Research Service, Arlington, Va.
METHOD OF ASSESSING CHANGES IN BIORHYTHMOLOGICAL STRUCTURE OF HUMAN PHYSIOLOGICAL FUNCTIONS **c52**
I. F. Vaysburd *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 99-106 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 71-73 (For primary document see N88-26069 19-51)
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Investigation of functional changes in man over a 24 hr period is an important task for space medicine. Individual cosinor analysis (ICA), which involves creation of models of baseline data in the form of appropriate combinations of algebraic and trigonometric functions, has gained the greatest popularity. The method proposed calls for analysis of variability of three parameters of a cosinor model (mean level, acrophase and amplitude) obtained for sliding observation intervals. The following objectives are set: to assess the degree of adaptation of the time structure of human physiological functions to extreme factors, and to describe quantitatively the wandering zone not only of acrophases, but other biorhythm parameters, lability or stability of the circadian system. The method is illustrated and discussed. Author

N88-26089# Joint Publications Research Service, Arlington, Va.
USE OF PRINCIPAL COMPONENT METHOD FOR ANALYSIS OF MULTIDIMENSIONAL QUANTITATIVE DATA IN BIOMEDICAL INVESTIGATIONS
S. L. Chekanova, T. M. Smirnova, and M. A. Matrosova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 103-106 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 73-75 (For primary document see N88-26069 19-51)
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The principal component method (PCM) is being used with success for analysis of multidimensional biomedical data of the quantitative type. It permits compression of information contained in the measured parameters and concentration of its main part in several numbers, values of the first principle component (PC) that explain a significant share of the scatter of the baseline. PCM is used to solve three important classes of problems in the area of biomedical investigations: formation of general evaluations (integral parameters) on the basis of a set of observed characters; classification of objects of observation in the space of generalized parameters; quantitative description of certain characteristics of objects as a function of values on integral ratings. PCM involves the use of orthogonal conversion of observed variables in order to obtain new, uncorrelated variables - PC having the following properties: scatter of point projections over the first PC is at a maximum, as compared to all other directions; the sum of the squares of distances from original points to their projections on the first PC is minimal. PCM is further discussed and illustrated. Author

N88-26090# Joint Publications Research Service, Arlington, Va.
AUTOMATED SPECTROMETRIC UNIT FOR THE STUDY OF RADIATION CHARACTERISTICS OF COSMIC RADIATION ABOARD PROGNOZ-9 SPACE STATIONS **c19**
V. M. Petrov, Yu. I. Logachev, S. N. Karachevskiy, V. V. Bengin, I. K. Gvozdev, G. Ya. Kolesov, M. I. Kudryavtsev, A. I. Martynov, A. N. Podorolskiy, and S. A. Sud *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 107-111 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 75-78 (For primary document see N88-26069 19-51)
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At the present time there is no question that progress in investigation of the aggregate of processes in the active region of the Sun, defined as a solar proton even (SPE) is possible only on the basis of combined analysis of its diverse components. Analysis is usually made to restore the measured spectra of solar cosmic ray to the source and investigate the characteristics of the spectrum of accelerated particles thus determined with consideration of the various possible mechanisms of generation and injection. In order to improve the effectiveness of taking measurements, it becomes necessary to form a special measuring complex that would permit not only obtaining data about the amplitude characteristics of various SPE factors, but time analysis of different factors and time relationship between them. Hence, it is necessary to measure SPE characteristics with high informativeness. A spectrometric unit was developed, which is intended for investigation of SPE in the range of charged particle energy from a few hundreds of MeV/nucleon and hard X-radiation in experiments aboard space stations. The unit is described and discussed. Author

N88-26091# Joint Publications Research Service, Arlington, Va.
LIQUID-PHASE OXIDATION OF ACETONE WITH HYDROGEN PEROXIDE ON OXIDE CATALYSTS **c54**
I. I. Vasilenko, N. M. Shevel, and Yu. Ye. Sinyak *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 112-116 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 78-81 (For primary document see N88-26069 19-51)
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Deep catalytic oxidation of organic substances is important to life support systems. When regenerating water in water supply systems for spacecraft crews, it is desirable to effect oxidation of organic impurities in water at a low temperature before formation of end products of the CO2, H2O, etc., type. These requirements limit considerably the range of catalysts and oxidants suitable for such purposes. The oxidative catalytic method based on using molecular oxygen as oxidant involves expenditure of energy for evaporation of water and heating catalysts to temperatures of at least 150 C. It is promising to use hydrogen peroxide, which is a potent and ecologically pure oxidant for destructive liquid phase oxidation of organic impurities. Use of homogeneous oxidation catalysts is not recommended for water reclamation systems, since this leads to secondary water pollution by heavy metal compounds. For this reason, it is more expedient to oxidize water impurities on heterogeneous catalysts for life support systems of the closed type. This theory is further discussed. Author

N88-26092# Joint Publications Research Service, Arlington, Va.
HUMAN ERYKTHROCYTE METABOLISM IN THE PRESENCE OF HYPEROXYGENATION DURING ANTIORTHOSTATIC HYPOKINESIA **c52**
V. Ye. Vorobyev, V. F. Ivchenko, and L. L. Stazhadze *In its* JPRS Report: Science and Technology. USSR: Space Biology and

Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 117-118 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, Jan.-Feb. 1988 p 81-82 (For primary document see N88-26069 19-51)
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A study of the effects of high concentrations of oxygen at normal barometric pressure should include evaluation of respiratory function of blood, which serves as the central element in the transport of gases, connecting external and tissue respiration. The question of effect of high oxygen concentrations on respiratory function of blood is of some interest to space biology and medicine. In particular, it is important to understand how red cell metabolism, which is one of the limiting factors of maximum permissible exposure of man to a hyperoxic environment, changes under normobaric hyperoxic conditions. However, there is very sparse information about erythrocyte metabolism in weightlessness or conditions that simulate it. Some of the mechanisms in the system of the blood's response to hyperoxia in healthy people was investigated in a series of studies using antiorthostatic hypokinesia. Author

N88-26093# Joint Publications Research Service, Arlington, Va.
EFFECT OF DIFFERENT MODES OF VOLUNTARY CONTROL OF BREATHING ON HUMAN ELECTROENCEPHALOGRAM WITH EXPOSURE TO ACUTE HYPOXIC HYPOXIA **c52**
Ye. P. Gora *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 119-121 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, Jan.-Feb. 1988 p 82-84 (For primary document see N88-26069 19-51)
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The search for means of enhancing effectiveness of human adaptation to low barometric pressure is of great scientific and practical importance to space biology and aerospace medicine. It is assumed that voluntary control of breathing may be one of the means of achieving this. At present there is no clear cut idea about the distinctions of the effect of voluntary control of breathing on change in functional state of the central nervous system and, in particular, electrical activity of the brain during adaptation to acute hypoxic hypoxia. The mechanisms of this feedback was investigated using some modes of voluntary control of respiration during exposure to acute hypoxia corresponding to an altitude of 5000 m. Methods and results are discussed. Author

N88-26094# Joint Publications Research Service, Arlington, Va.
EXPERIMENTAL STUDY OF PROTECTIVE EFFECT OF ANTIOXIDANT ENZYMES-SUPEROXIDE DISMUTASE AND CATALASE-WHEN USING INTERMITTENT TOXIC MODES OF HYPERBARIC OXYGENATION **c52**
F. A. Zvershkhanovskiy, M. A. Simonyan, and Yu. A. Pilipenko *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 122-125 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, Jan.-Feb. 1988 p 84-86 (For primary document see N88-26069 19-51)
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Formation in the body of active forms of oxygen is the triggering factor of oxygen intoxication when using toxic modes of hyperbaric oxygenation (HBO); they have the capacity to react with endogenous substrates with formation of organic peroxides. Peroxide compounds have an inactivating effect on oxide reductase, as a result, the cell loses the capacity to utilize surplus oxygen. Superoxide dismutase (SOD), catalase and glutathione peroxide play an important role in dismutation of superoxide radicals. These enzymatic antioxidants (AO) manifest their stabilizing effect by inhibiting free radical oxidation of lipids in biological membranes. Exposure to toxic HBO is associated with decrease in activity of these AO, which leads to accumulation of lipid peroxides in excess of the physiological reserve of the antioxidant system. The prevention of the toxic effect of hyperbaric oxygen by means of administration of exogenous SOD and catalase was studied and is discussed. Author

N88-26095# Joint Publications Research Service, Arlington, Va.
METHOD FOR MEASURING ABSOLUTE LINEAR PARAMETERS OF CHROMOSOMES **c52**
L. I. Chabala *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 126-128 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, Jan.-Feb. 1988 p 86-87 (For primary document see N88-26069 19-51)
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Some attention is given to change in chromosome morphology in studies of the effects of spaceflight factors on the body. At present, the method of measuring chromosomes in relative units on microphotographs or drawings from a negative is used extensively. A method is known of measuring microscopic objects in microns under a microscope, using the scale of an eyepiece micrometer. When examining chromosomes under a microscope with a 90x lens, a 7x eyepiece is used, which has an attachment for the ocular micrometer. In this case, the ocular micrometer has a scale factor of 2 microns. But in some animal species, the chromosomes are about 2 microns in size. For them the above scale factor is rather large and does not permit accurate measurement. For this reason, a method was developed for measuring the absolute linear parameters of chromosomes, which will permit mass scale analysis with higher precision. Author

N88-26096*# Lockheed Engineering and Management Services Co., Inc., Washington, D.C.
USSR SPACE LIFE SCIENCES DIGEST, ISSUE 18
Lydia Razran Hooke, ed., P. Lynn Donaldson, ed., Ronald Teeter, ed., Victoria Garshnek, ed., and Joseph Rowe, ed. (Library of Congress, Washington, D. C.) Washington NASA Jul. 1988 140 p
(Contract NASw-4292)
(NASA-CR-3922(21); NAS 1.26:3922(21)) Avail: NTIS HC A07/MF A01 CSCL 06B

This is the 18th issue of NASA's USSR Life Sciences Digest. It contains abstracts of 50 papers published in Russian language periodicals or presented at conferences and of 8 new Soviet monographs. Selected abstracts are illustrated with figures and tables from the original. A review of a recent Aviation Medicine Handbook is also included. The abstracts in this issue have been identified as relevant to 37 areas of space biology and medicine. These areas are: adaptation, aviation medicine, biological rhythms, biospherics, body fluids, cardiovascular and respiratory systems, cytology, developmental biology, endocrinology, enzymology, equipment and instrumentation, exobiology, gastrointestinal system, genetics, gravitational biology, group dynamics, habitability and environmental effects, hematology, human performance, immunology, life support systems, man-machine systems, mathematical modeling, metabolism, microbiology, musculoskeletal system, neurophysiology, nutrition, operational medicine, perception, personnel selection, psychology, radiobiology, reproductive biology, space biology and medicine, and space industrialization. Author

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N88-26097# Signition, Inc., Los Alamos, N. Mex. Hearing Research Lab.
[NOVEL NONLINEAR SIGNAL PROCESSING PRINCIPLES] Final Report
George Zweig 30 Sep. 1987 6 p
(Contract N00014-86-C-0051)
(AD-A191644) Avail: NTIS HC A02/MF A01 CSCL 20A

Research has been directed towards discovering novel

nonlinear signal processing principles by studying the way in which the inner ear analyzes sound and encodes the information contained therein as neural impulses. These principles may be abstracted from the context of hearing and usefully applied to the analysis of any type of nonstationary signal containing both time and frequency information. Applications of this work to the recognition of speech in noisy environments and the classification of ocean sounds are expected. The central research problem has been the characterization of the nonlinear mechanics of the inner ear and the elucidation of its role in signal processing. The mechanics of the inner ear at low sound pressure levels (levels of unvoiced speech) has been accurately characterized with the unexpected conclusion that the inner ear functions as an active nonlinear one-dimensional mechanical transmission line with negative feedback involving delay. The parameters defining the circuit elements vary gradually along the line. Each section of the line contains a negatively damped harmonic oscillator stabilized by the feedback of a force proportional to the displacement of the oscillator at a time in the past, where the time delay of the force is proportional to the oscillator's period. GRA

N88-26098# Helsinki Univ. of Technology, Espoo (Finland). Low Temperature Lab.
CONTRA- AND IPSILATERAL AUDITORY STIMULI PRODUCE DIFFERENT ACTIVATION PATTERNS AT THE HUMAN AUDITORY CORTEX: A NEUROMAGNETIC STUDY
J. P. Maekelae Feb. 1988 22 p
(PB88-181490; TKK-F-A625; ISBN-951-754-399-9) Avail: NTIS HC A03/MF A01 CSCL 06P

Auditory evoked magnetic fields were recorded over the right hemisphere of healthy humans. The stimuli were noise bursts presented either to the contra (C) or ipsilateral (I) ear in different combinations. The largest deflection of the responses, N100m (magnetic counterpart of electric N100), showed a field pattern which suggests activation of the supratemporal auditory cortex. in an oddball paradigm, where the standards (90 percent) were 400 ms noise bursts presented to the contralateral ear, and the deviants (10 percent) similar stimuli to the ipsilateral ear, the deviants elicited on the average 130 percent stronger equivalent dipoles of N100 m than the standards. When two 50 ms noise bursts, separted by 300 ms, were presented once every 2 s, N1000 m evoked by the second stimulus of the pair was smaller when the stimuli were presented monaurally (C - C or I - I) than to different ears (C - I, I - C). The results suggest that contra and ipsilateral auditory stimuli are analyzed, at least inpart, in different neural networks at the human auditory cortex. GRA

N88-26018# GKSS-Forschungszentrum Geesthacht (West Germany).
EXPERIENCE IN OCCUPATIONAL MEDICINE, DERIVED FROM 16 OPERATIONAL DEEP SATURATION TRIMIX 5 DIVES IN GUSI FROM 150 TO 600 m
Justus Holthaus *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 25-29 (For primary document see N88-26016 19-51)
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N88-26019# Compagnie Maritime d'Expertises, Marseille (France). Hydra Research Programme.
LIFE IN A HYPERBARIC ENVIRONMENT. A NEW O2-H2 BREATHING MIXTURE FOR INDUSTRIAL DIVING
Bernard Gardette, M. Comet, C. Gortan, J. P. Imbert, X. Fructus, and H. G. Delauze *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 31-40 (For primary document see N88-26016 19-51)
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N88-26020# Reims Univ., France. Lab. de Psychologie Appliquee.
STRESS IN RELATION TO THE PHYSICAL AND SOCIAL ENVIRONMENT [STRESS EN RAPPORT AVEC L'ENVIRONNEMENT PHYSIQUE ET SOCIAL]
Jean Rivolier *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 41-45 In FRENCH (For primary document see N88-26016 19-51)
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N88-26029# Direction des Constructions et Armes Navales, Toulon (France). Centre d'Etudes et de Recherche Techniques Sous-Marines.
CONTRIBUTION OF ULTRASONIC DOPPLER DETECTION OF CIRCULATING BUBBLES TO HUMAN INTERVENTIONS UNDER THE SEA AND IN SPACE [APPORT DE LA DETECTION ULTRASONORE PAR EFFET DOPPLER DES BULLES CIRCULANTES AUX INTERVENTIONS HUMAINES EN MER ET DANS L'ESPACE]
Gerard Masurel, R. Guillerm, and L. Giacomoni *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 99-102 In FRENCH (For primary document see N88-26016 19-51)
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N88-26035# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. for Aerospace Medicine.
DECOMPRESSION PROCEDURES AND ACCIDENTS IN SPACE AND SEA
Juergen Wenzel and L. Vogt *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 139-147 (For primary document see N88-26016 19-51)
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N88-26070# Joint Publications Research Service, Arlington, Va.
RESULTS OF MEDICAL RESEARCH CONDUCTED IN 1985 DURING LONG-TERM SPACEFLIGHTS
A. D. Yegorov, O. D. Anashkin, O. G. Itsekhovskiy, I. V. Alferova, Z. A. Golubchikova, V. R. Lyamin, A. P. Polyakova, V. F. Turchaninova, V. A. Talavrinov, and V. D. Turbasov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 1-4 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 4-7 (For primary document see N88-26069 19-51)
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HUMAN HEMODYNAMICS DURING WATER IMMERSION AS RELATED TO POSITION DURING SUBMERSION
A. M. Genin, A. Yu. Modin, and V. S. Shashkov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 5-8 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 7-10 (For primary document see N88-26069 19-51)
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N88-26072# Joint Publications Research Service, Arlington, Va.
HEMOSTASIS PARAMETERS OF INDIVIDUALS WITH NEUROCIRCULATORY DYSTONIA SUBMITTED TO DRY IMMERSION
L. L. Kirichenko, V. P. Masenko, A. B. Raskurazhev, and A. G. Yevdokimova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 9-12 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 10-13 (For primary document see N88-26069 19-51)
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N88-26073# Joint Publications Research Service, Arlington, Va.
SIGNIFICANCE OF NUTRITION TO CHANGE IN HUMAN CARBOHYDRATE AND LIPID METABOLISM UNDER EMOTIONAL STRESS
V. P. Bychkov, L. I. Mosyakina, and O. S. Khokhlova *In its* JPRS Report: Science and Technology. USSR: Space Biology and

Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 13-17 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 13-17 (For primary document see N88-26069 19-51)
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ANALYSIS OF CLINICAL SYMPTOMS OF HUMAN DECOMPRESSION SICKNESS DURING ALTITUDE CHAMBER STUDIES
L. R. Iseyev, A. S. Tsivilashvili, and V. I. Chadov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 18-22 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 17-21 (For primary document see N88-26069 19-51)
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N88-26075# Joint Publications Research Service, Arlington, Va.
ELECTROENCEPHALOGRAPHIC CHANGES DURING EQUILIBRIUM TEST IN THE PRESENCE OF RHYTHMIC PHOTIC INTERFERENCE
Ye. T. Petrenko *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 23-28 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 21-25 (For primary document see N88-26069 19-51)
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N88-26077# Joint Publications Research Service, Arlington, Va.
NONINVASIVE EXAMINATION OF BONES DURING LONG-TERM HYPOKINESIA
V. S. Oganov, A. S. Rakhmanov, B. V. Morukov, Kh. A. Yanson, A. M. Tatarinov, V. Ye. Zaychik, S. K. Ternovoy, and C. Cann *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 35-40 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 30-33 (For primary document see N88-26069 19-51)
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N88-26081# Joint Publications Research Service, Arlington, Va.
EFFECT OF LOW-FREQUENCY WHOLE-BODY VERTICAL VIBRATION ON THE SEROTONINERGIC SYSTEM OF THE BRAIN AND SPINAL CORD
A. S. Dmitriyev and G. K. Tropnikova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 58-63 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 45-49 (For primary document see N88-26069 19-51)
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N88-26082# Joint Publications Research Service, Arlington, Va.
DISTINCTIVE FEATURES IN BLOOD CLOTTING AND FIBRINOLYTIC PROPERTIES UNDER EFFECT OF EPINEPHRINE IN PRESENCE OF HYPOXIA AND HYPERCAPNIA
G. D. Pak, V. S. Sverchkov, T. N. Danilevskaya, and T. P. Trandafilova *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 64-69 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1. Jan.-Feb. 1988 p 49-53 (For primary document see N88-26069 19-51)
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N88-26084# Joint Publications Research Service, Arlington, Va.
EFFECT OF LONG-TERM INHALATION OF ACETIC ACID VAPOR ON SOME FUNCTIONAL PARAMETERS OF MAN
V. P. Savina and B. V. Anisimov *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 77-82 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 57-61 (For primary document see N88-26069 19-51)
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N88-26088# Joint Publications Research Service, Arlington, Va.
METHOD OF ASSESSING CHANGES IN BIORHYTHMOLOGICAL STRUCTURE OF HUMAN PHYSIOLOGICAL FUNCTIONS
I. F. Vaysburd *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 99-106 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 71-73 (For primary document see N88-26069 19-51)
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HUMAN ERYKTHROCYTE METABOLISM IN THE PRESENCE OF HYPEROXYGENATION DURING ANTIORTHOSTATIC HYPOKINESIA
V. Ye. Vorobyev, V. F. Ivchenko, and L. L. Stazhadze *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 117-118 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, Jan.-Feb. 1988 p 81-82 (For primary document see N88-26069 19-51)
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EFFECT OF DIFFERENT MODES OF VOLUNTARY CONTROL OF BREATHING ON HUMAN ELECTROENCEPHALOGRAM WITH EXPOSURE TO ACUTE HYPOXIC HYPOXIA
Ye. P. Gora *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 119-121 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, Jan.-Feb. 1988 p 82-84 (For primary document see N88-26069 19-51)
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N88-26094# Joint Publications Research Service, Arlington, Va.
EXPERIMENTAL STUDY OF PROTECTIVE EFFECT OF ANTIOXIDANT ENZYMES-SUPEROXIDE DISMUTASE AND CATALASE-WHEN USING INTERMITTENT TOXIC MODES OF HYPERBARIC OXYGENATION
F. A. Zvershkhanovskiy, M. A. Simonyan, and Yu. A. Pilipenko *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 122-125 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, Jan.-Feb. 1988 p 84-86 (For primary document see N88-26069 19-51)
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N88-26095# Joint Publications Research Service, Arlington, Va.
METHOD FOR MEASURING ABSOLUTE LINEAR PARAMETERS OF CHROMOSOMES
L. I. Chabala *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 126-128 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, Jan.-Feb. 1988 p 86-87 (For primary document see N88-26069 19-51)
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53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N88-26099# Naval Aerospace Medical Research Lab., Pensacola, Fla.
PREDICTING AIR COMBAT MANEUVERING (ACM) PERFORMANCE: FLEET FIGHTER ACM READINESS PROGRAM GRADES AS PERFORMANCE CRITERIA Interim Report, 1986 - 1987
G. R. Griffin, T. R. Morrison, T. L. Amerson, and P. V. Hamilton Oct. 1987 38 p
(AD-A191605; NAMRL-1333) Avail: NTIS HC A03/MF A01 CSCL 01B

A difficult aspect of predicting fleet pilot performance is acquiring meaningful and reliable, inflight criteria. Without such criteria, performance assessment is both theoretically and realistically impossible. This study was an attempt to predict Air Combat Maneuvering (ACM) performance using performance-based laboratory tests and to evaluate the VF-43 adversary squadron's grading of inflight ACM performance in the Fleet Fighter ACM Readiness Program at Naval Air Station Oceana. The purpose of the latter effort was to select convenient and reliable criteria for ACM performance assessment and use in the validation of the laboratory tests. In an initial evaluation (Study 1), F-4 pilots performed in Fleet Fighter ACM Readiness exercises and completed performance-based perceptual motor and multitask tests. Results indicated that dichotic listening test measures, obtained during multitask conditions, could be used to reliably predict ACM inflight criteria. Results of a larger sample of F-14 pilots (Study 2) indicated that an overall ACM grade (OAG) assigned by VF-43 adversary personnel can be predicted reliably by an objective kill difference composite score and three subjective measures: situational awareness, mutual support, and energy management. These four measures accounted for 78% of the variance with the OAG. A correlational analysis suggests that the VF-43 grading process is reliable and consistent. GRA

N88-26100# Brown Univ., Providence, R. I. Dept. of Physics.
GENERALIZATION AND THE BACKWARD PROPAGATION NEURAL NETWORK
Charles M. Bachmann 14 Jan. 1988 10 p
(Contract DAAG29-84-K-0202)
(AD-A191634; ARO-22000.9-LS) Avail: NTIS HC A02/MF A01 CSCL 23C

The capacity of model neural networks to generalize from a partial set of information is an area of much current interest. It addresses the issue of how accurate current models are of higher cognitive processes; the ability to categorize input, to make generalizations based on a limited set of information, is one of the hallmarks of these processes. In this context, the author has been investigating the Backward Propagation of Error Model due to Rumelhart et. al. The model is a deterministic approach which seeks to teach a desired input-output mapping by repeated presentation of the desired mapping to the system, correcting the system connections based on the error in output. We have begun to address the generalization capability of this system. Specifically, we have studied to what extent the set of connections which evolve in learning a partial set of patterns are a general solution to a given mapping. That is, if we teach several examples of a mapping to the system, will the solutions that the system discovers for these patterns be capable of generalizing and correctly identifying other input states that have not been seen. The results of some simulations undertaken to address this question are discussed and some modifications to the model which we have proposed are indicated. GRA

N88-26021# Bergen Univ. (Norway). Inst. of Physiological Psychology.
SELECTING THE RIGHT CREW FOR FUTURE SPACE STATIONS: AN ANALYSIS OF SELECTION RESEARCH ON OFFSHORE DIVERS, AVIATION PILOTS AND OTHER HIGH RISK GROUPS IN SCANDINAVIA
R. J. Vaernes, M. Warncke, T. Bergan, and Holger Ursin *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 47-51 (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26026# Reims Univ., France. Lab. de Psychologie Appliquee.
SELECTION AND TRAINING OF SUBJECTS TO LIVE AND WORK IN HOSTILE AND UNUSUAL ENVIRONMENTS [SELECTION ET PREPARATION PSYCHOLOGIQUES DES SUJETS AYANT A VIVRE ET TRAVAILLER EN ENVIRONNEMENTS INHABITUELS ET HOSTILES]
Jean Rivolier and G. Cazes *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 87-89 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26028# Service de Sante des Armees, Dijon (France).
SELECTION OF ISOLATED SPACE CREWS [SELECTION DES PERSONNELS ISOLES DE L'ESPACE]
E. Leighton *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 95-98 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N88-26101# Douglas Aircraft Co., Inc., Long Beach, Calif.
PROCEEDINGS OF THE WORKSHOP ON THE ASSESSMENT OF CREW WORKLOAD MEASUREMENT METHODS, TECHNIQUES AND PROCEDURES. VOLUME 2: LIBRARY REFERENCES Final Report, 24-25 Feb. 1987
M. A. Biferno and George Boucek, Jr. (Boeing Aerospace Co., Seattle, Wash.) Jun. 1987 140 p
(Contract F33615-86-C-3600)
(AD-A191209; AFWAL-TR-87-3043-Vol-2) Avail: NTIS HC A07/MF A01 CSCL 05I

Workload measurement methods of validity, reliability, and applicability are presented. This is a reference of the results of an analysis of a large sample of workload literature. It contains: (1) a listing by author of all references examined, (2) a listing of references by article number, and (3) a fact matrix. The fact matrix provides an index which identifies articles addressing measure reliability or validity and associates them with FAR 25 Appendix D definitions of Workload type. Author

N88-26102 Association pour le Developpement de l'Enseignement et de la Recherche en Systematique Appliquee, Verrieres-le-Buisson (France).
RESEARCH ON PILOTING UNDER CONDITIONS OF BREAKDOWN IN FLIGHT Final Report
D. Viard Mar. 1987 196 p In FRENCH Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France
(PB87-217980) Avail: NTIS HC E09/MF E09; copy not available from STI Facility CSCL 05H

An experiment on piloting during a breakdown involving 11 simulation sessions on N262 with 16 pilot students at the end of training is described. Objectives: analysis of possible paradoxical reactions and methodological research combining various (variable) aspects including nature of breakdown, individual traits, previous

experience, flight process, etc. Conclusions are drawn in particular with respect to the variable contribution of the team members to the work rhythm (linkage), the role of situational attitudes (appreciation of breakdown, reactions to limiting conditions created, etc.), the variability of actions permitted by the complexity and redundancy of the situations, the impact of breakdowns on overall flight planification, as well as on the irregular performance of the execution phases. Author

N88-26103# Stanford Linear Accelerator Center, Calif.
INTRODUCTION TO HUMAN FACTORS
J. M. Winters Mar. 1988 10 p Presented at the SHARE Conference, Anaheim, Calif., 28 Feb. 1988
(Contract DE-AC03-76SF-00515)
(DE88-009021; SLAC-PUB-4561; CONF-880233-2) Avail: NTIS HC A02/MF A01

Some background is given on the field of human factors. The nature of problems with current human/computer interfaces is discussed, some costs are identified, ideal attributes of graceful system interfaces are outlined, and some reasons are indicated why it's not easy to fix the problems. DOE

N88-26104*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
LARGE PLANAR MANEUVERS FOR ARTICULATED FLEXIBLE MANIPULATORS Progress Report, period ended 31 May 1988
Jen-Kuang Huang and Li-Farn Yang Jul. 1988 29 p
(Grant NAG1-830)
(NASA-CR-183079; NAS 1.26:183079) Avail: NTIS HC A03/MF A01 CSCL 05H

An articulated flexible manipulator carried on a translational cart is maneuvered by an active controller to perform certain position control tasks. The nonlinear dynamics of the articulated flexible manipulator are derived and a transformation matrix is formulated to localize the nonlinearities within the inertia matrix. Then a feedback linearization scheme is introduced to linearize the dynamic equations for controller design. Through a pole placement technique, a robust controller design is obtained by properly assigning a set of closed-loop desired eigenvaiues to meet performance requirements. Numerical simulations for the articulated flexible manipulators are given to demonstrate the feasibility and effectiveness of the proposed position control algorithms. Author

N88-26105# Lawrence Livermore National Lab., Calif.
THE RELATIONSHIP BETWEEN SYSTEM RESPONSE TIME, WORKING MEMORY, AND TASK COMPLEXITY: AN EMPIRICAL INVESTIGATION
E. E. Schultz, Jr., J. Y. Uejio, and A. M. DeAlvare 15 Sep. 1987 12 p Presented at the Computer Human Interaction Conference, Washington, D.C., 15 May 1988
(Contract W-7405-eng-48)
(DE88-000976; UCRL-97342; CONF-880516-3) Avail: NTIS HC A03/MF A01

An experiment tested whether: (1) user performance decrements due to system response time (SRT) results from working memory disruption, and (2) SRT effects vary with task complexity. Subjects performed one- and three-step tasks resembling use of a screen editor while attempting to remember zero, three, or six digits. After each task step, SRT's of either zero, two, or six seconds were imposed. SRT increased task completion time, although more for the complex than for the simple task. There was neither a significant interaction between SRT and memory load, nor a main effect of memory load, showing that SRT does not disrupt working memory. DOE

N88-26017# Direction des Constructions et Armes Navales, Toulon (France). Centre d'Etudes et de Recherches Techniques Sous-Marines.
PHYSIOLOGICAL EFFECTS ON MAN OF LONG DURATION CONFINEMENT IN A CARBON DIOXIDE ENRICHED ENVIRONMENT [EFFETS PHYSIOLOGIQUES CHEZ L'HOMME DU CONFINEMENT DE LONGUE DUREE EN ATMOSPHERE ENRICHIE EN DIOXYDE DE CARBONE]
Eugene Radziszewski, L. Giacomoni, and R. Guillerm *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 19-23 In FRENCH (For primary document see N88-26016 19-51)
(Contract DRET-79-1098)
Copyright Avail: NTIS HC A15/MF A01

N88-26023# Centre d'Essais en Vol, Bretigny-Air (France). Lab. de Medecine Aerospatiale.
SPACE CABIN ATMOSPHERE AND EXTRACURRICULAR SORTIE [ATMOSPHERE D'UNE CABINE SPATIALE ET SORTIE EXTRA-VEHICULAIRE]
Henri Marotte and Marc Weibel (Avions Marcel Dassault-Breguet Aviation, Saint-Cloud, France) *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 69-76 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26024# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
TECHNICAL CHALLENGES IN THE DEVELOPMENT OF A EUROPEAN SPACE SUIT SYSTEM AND COMPARISON WITH UNDERWATER SUITS
D. Isakeit *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 77-82 (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26027# Norges Tekniske Hoegskole, Trondheim. Div. of Medical Technology.
SIMILARITIES BETWEEN DIVING OPERATIONS AND SPACE MISSIONS
Greta Bolstad *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 91-94 (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26030# Institut Francais de Recherche pour l'Exploitation de la Mer, La Seyne sur Mer.
DIFFERENT TECHNIQUES FOR INTERVENING UNDER THE SEA: POSSIBLE LINKS WITH SPACE APPLICATIONS [LES DIFFERENTES TECHNIQUES D'INTERVENTION SOUS LA MER - LEURS LIENS POSSIBLES AVEC LE DOMAINE SPATIAL]
B. Grandvaux *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 109-113 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26032# Institut Francais de Recherche pour l'Exploitation de la Mer, La Seyne sur Mer.
ERGONOMY AND INTERIOR FURNISHING OF THE CABINS OF DEEP DIVING MANNED SUBMARINES: THE NAUTILE EXAMPLE [ERGONOMIE ET AMENAGEMENTS INTERIEURS DES HABITACLES DES SOUS-MARINS HABITES GRANDE PROFONDEUR. EXAMPLE: LE NAUTILE]
J. F. Drogou, L. Giacomoni, and Eugene Radziszewski *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 121-123 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26033# Bell and Trotti, Inc., Houston, Tex.
HABITABILITY OF THE SPACE STATION: FROM VEHICLE TO LIVING SPACE [HABITABILITE DE LA STATION SPATIALE. DU VEHICULE AU LIEU DE VIE]
Francis Winisdoerffer *In* ESA, Proceedings of the Colloquium

on Space and Sea Mar. 1988 p 125-134 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26034# Compagnie Maritime d'Expertises, Marseille (France).
THE SAGA HIGHLY AUTONOMOUS ASSISTANCE SUBMARINE [SAGA: SOUS-MARIN D'ASSISTANCE A GRANDE AUTONOMIE]
Jean Mollard and B. Grandvaux (Institut Francais de Recherche pour l'Exploitation de la Mer, La Seyne sur Mer.) *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 135-138 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26036# Norges Tekniske Hoegskole, Trondheim. Div. of Medical Technology.
MONITORING OF DIVERS/ASTRONAUTS DURING MISSIONS
Bard Holand and Greta Bolstad *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 149-153 (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26038# Avions Marcel Dassault-Breguet Aviation, Saint-Cloud (France).
SAFETY OF EXTRAVEHICULAR SPACE ACTIVITIES [SECURITE DES ACTIVITES SPATIALES EXTRA-VEHICULAIRES]
Jacques Laloe *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 161-168 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26039# Southern California Inst. of Architecture, Santa Monica. Space Projects Group.
RECENT RESEARCH ON CREW WARDROOM HABITABILITY FOR THE SPACE STATION
D. Nixon, Regis Fauquet, and T. Taylor *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 169-173 (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26040# Institut Francais de Recherche pour l'Exploitation de la Mer, La Seyne sur Mer.
UNDERWATER SIMULATION FOR SPACE TELEOPERATION
J.-L. Michel and J.-F. Drogou *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 175-176 (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26041# Norwegian Marine Technology Research Inst., Trondheim.
MARINTEK'S OCEAN BASIN, A TRAINING FACILITY FOR EXTRAVEHICULAR ACTIVITY?
Tor Einer Berg *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 177-182 (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26042# Bureau Veritas, Courbevoie (France).
REDUCING RISKS INHERENT IN OPERATING UNDERWATER CRAFT: THE CONTRIBUTION OF CLASSIFICATION, THE EXAMPLE OF THE SAGA HIGHLY AUTONOMOUS SUPPORT SUBMARINE [REDUIRE LES RISQUES INHERENTS A L'OPERATION DES ENGINS SOUS-MARINS: L'APPORT DE LA CLASSIFICATION, L'EXEMPLE DU SAGA]
D. Berdin *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 183-189 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26043# CGR MeV, Buc (France).
SPACE AND SEA: IS THERE A PLACE FOR IONIZATION? [ESPACE ET MER: L'IONISATION AURA-T-ELLE SA PLACE?]
T. Sadat and C. Cuillandre *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 191-192 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26044# Centre National d'Etudes Spatiales, Toulouse (France).
TASKS FORESEEN FOR SPACE ROBOTS AND AN EXAMPLE OF AN ASSOCIATED ORBITAL INFRASTRUCTURE [TACHES ENVISAGEES POUR LES ROBOTS SPATIAUX ET EXEMPLE D'INFRASTRUCTURE ORBITAL ASSOCIEE]
Pierre Dutto *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 199-208 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26045# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
MAN VERSUS MACHINE: THE ROLE OF ASTRONAUTS IN EXTRAVEHICULAR ACTIVITY
E. Olier *In its* Proceedings of the Colloquium on Space and Sea Mar. 1988 p 213-218 (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26046# MATRA Espace, Paris-Velizy (France).
COMPUTER AIDED REMOTE CONTROL: A GENERAL CONCEPT FOR INTERVENTION IN THE NUCLEAR, UNDERWATER, AND SPACE DOMAINS [TAO: TELEOPERATION ASSISTEE PAR ORDINATEUR. UN CONCEPT GENERIQUE POUR L'INTERVENTION EN MILIEU NUCLEAIRE, SOUS-MARIN OU SPATIAL]
Guy Andre and Raymond Fournier (Commissariat a l'Energie Atomique, Fontenay-aux-Roses, France) *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 221-231 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26047# Ifremer, Paris (France).
MARINE TECHNIQUES: R AND D AXES, IDENTIFICATION OF AREAS OF COMMON INTEREST WITH SPACE TECHNIQUES [TECHNIQUES MARINES: AXES DE R ET D. IDENTIFICATION DE DOMAINES D'INTERET COMMUN AVEC LES TECHNIQUES SPATIALES]
Fabrice Theobald *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 233-234 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26048# Institut Francais de Recherche pour l'Exploitation de la Mer, La Seyne sur Mer.
ELIT: AN AUTONOMOUS UNDERWATER OBSERVATION ROBOT [ELIT: UN ROBOT SOUS-MARIN D'OBSERVATION AUTONOME]
P. Borot and L. Brisset *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 235-241 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26049# Societe Generale de Construction Electriques et Mechaniques Alsthom, Nantes (France). Etablissement ACB Energie.
UNDERWATER ROBOTICS IN THE SERVICE OF OIL FIELD EXPLOITATION: THE RUNNING AND INTERCONNECTING TOOL (RIT) IN THE EAST FRIGG FIELD (NORTH SEA) [LA ROBOTIQUE SOUS-MARINE AU SERVICE DE L'EXPLOITATION PETROLIERE: L'ENGIN RIT SUR LE CHAMP DE FRIGG-EST]
J. Chereau *In* ESA, Proceedings of the Colloquium on Space

and Sea Mar. 1988 p 243-246 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26052# Aeroformation Blagnac (France).
DEVELOPMENT OF TRAINING IMPLYING MAN-MACHINE INTERFACE: FROM THE AIRCRAFT TO THE SPACECRAFT [DEVELOPPEMENT DE FORMATION IMPLIQUANT L'INTERFACE HOMME-MACHINE: DE L'AVION AU VAISSEAU SPATIAL]
Jean-Francois Schmidt *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 257-259 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

N88-26091# Joint Publications Research Service, Arlington, Va.
LIQUID-PHASE OXIDATION OF ACETONE WITH HYDROGEN PEROXIDE ON OXIDE CATALYSTS
I. I. Vasilenko, N. M. Shevel, and Yu. Ye. Sinyak *In its* JPRS Report: Science and Technology. USSR: Space Biology and Aerospace Medicine, v. 22, no. 1, Jan.-Feb. 1988 23 Jun. 1988 p 112-116 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina, Moscow (USSR), v. 22, no. 1, Jan.-Feb. 1988 p 78-81 (For primary document see N88-26069 19-51)
Copyright Avail: NTIS HC A08/MF A01

55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N88-26106# Massachusetts Inst. of Tech., Cambridge.
ALGORITHMIC GENERATION OF FEASIBLE SYSTEM ARCHITECTURES
Pascal A. Remy and Alexander H. Levis Jan. 1988 12 p Prepared in cooperation with CGEE Alsthon, Massy, France
(Contracts N00014-85-K-0782; N00014-84-K-0519)
(AD-A191722; LIDS-P-1745) Avail: NTIS HC A03/MF A01
CSCL 12D

A methodology is presented for generating decision making organizational structures that satisfy some given requirements. Allowable interactions between organizational members are first defined and constraints are introduced. To find the set of structures that satisfy the requirements, a methodology has been designed that reduces the computational complexity of the problem and makes it tractable. The set of structures is delimited by its maximal and minimal elements and a technique is given to generate the entire set from its boundaries. Simple paths are introduced as the incremental unit leading from an organization to its neighboring ones. Lattice theory is used throughout the methodology as the underlying analytical tool. GRA

N88-26107# Lawrence Livermore National Lab., Calif.
ADVANCES IN PERSONAL COMPUTERS FOR SCIENTIFIC APPLICATIONS
D. E. Cullen Apr. 1988 12 p Presented at the International Centre for Physics Workshop on Applied Nuclear Theory and Nuclear Model Calculations for Nuclear Technology Application, Trieste, Italy, 5 Mar. 1988
(Contract W-7405-eng-48)
(DE88-009824; UCRL-98555; CONF-880342-2; CONF-880342)
Avail: NTIS HC A03/MF A01

Over just the last few years the power (in terms of speed and core size) of personal computers has grown at an incredible rate, which no one could have foreseen, and at the present time they have reached the point where it is practical to use personal computers for large scientific applications. What is truly amazing is that as the power of these personal computers has grown the price has remained relatively low. Of equal importance to the availability and cost of personal computers is the availability of computer software for use on these computers. At the current time personal computers have excellent FORTRAN compilers and related supporting software facilities and more and more application programs are being converted for use on personal computers. Today we have reached the point where the combination of personal computer power and low cost can allow even small institutes that cannot afford larger computers to have significant computer resources available for their use. DOE

N88-26108# Oak Ridge National Lab., Tenn.
MULTIDIMENSIONAL NODAL TRANSPORT METHODS FOR MULTIPLE-INSTRUCTION MULTIPLE-DATA DISTRIBUTED MEMORY MACHINES
Y. Y. Azmy 1988 7 p Presented at the American Nuclear Society Annual Meeting, San Diego, Calif., 12 Jun. 1988
(Contract DE-AC05-84OR-21400)
(DE88-004732; CONF-880601-2) Avail: NTIS HC A02/MF A01

As computer hardware technology approaches the physical limits of the electronic components of computer systems, it has become evident that any significant performance improvements must be rooted in advanced architectures. Efforts in this direction have resulted in numerous ideas and designs for vector and parallel processors, among which is the neutron and photon transport equation. Monte Carlo type methods have been implemented on Shared Memory (SM) and Distributed Memory (DM) Multiple-Instruction Multiple-Data (MIMD) machines. On the other hand, implementation of discrete-ordinates type methods on SM, MIMD systems has been considered for general codes, as well as special one-dimensional, multigroup codes. More recently, implementation of the latter code on the hypercube, and the comparison between two chaotic and one ordered iterative schemes have been reported. The implementation of the zeroth and first-order two-dimensional nodal transport methods on the hypercube are presented. The objective is to study the effect of the various parameters in a simple test problem on the speedup and efficiency is order to determine the cases most suitable for solving on a DM machine such as the hypercube. DOE

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N88-26109# Helsinki Univ. of Technology, Espoo (Finland). Lab. of Electromechanics.
ELECTROMECHANICAL RESEARCH SYMPOSIUM, AUGUST 20-21, 1987

Tapani Jokinen, ed. and Jyrki Uurtio, ed. 1987 63 p Symposium held 20-21 Aug. 1987
(PB88-148457; ISBN-951-754-275-5) Avail: NTIS HC A04/MF A01 CSCL 09B

The following papers are included: (1) On three-dimensional boundary element methods for magnetostatics in vector variables; (2) Simulation of the effect of winding harmonics and skewing on the start of a squirrel cage asynchronous motor; (3) Calculation of iron losses in a laminated toroid; (4) Calculation of the bar impedance using finite element method in one rotor slot pitch; (5) The steady-state operation point of a synchronous machine by finite-element method; (6) Comparison of constant and variable speed drives for wind turbines; and (7) An approach to transient behavior of an induction machine at 2-phase short circuit. GRA

N88-26110# PEDA Corp., Palo Alto, Calif.
ACCURATE, PRODUCTIVE AERODYNAMIC SIMULATION ON PATCHED MESH SYSTEMS Annual Report, 1 Oct. 1986 - 30 Sep. 1987
Charles K. Lombard, Joseph Oliger, Jorge Bardina, Ethiraj Venkatapathy, and J. Y. Yang 30 Nov. 1987 64 p
(Contract F49620-85-C-0081)
(AD-A192040; AFOSR-88-0185TR) Avail: NTIS HC A04/MF A01 CSCL 12E

The research has aimed at defining data structures and completing tools for a new flexible approach to scientific programming and problem solving. Both problems of program complexity associated with changing models and physics as well as joined and disjoint multiple independent patched domain decompositions for treating complex geometries can be systematically organized within the context of the directed graph programming concept being explored. Problems and parts of problems having geometric connectivity or its analogs such as precedence relationships are naturally exhibited and easily debugged or modified in the graph. The solution of problems is literally to traverse the graph. For the planned prototype aerodynamic simulation facility the graphs which are to embody grid generation and Navier Stokes solution procedures are to be constructed with a graphical editor hosted in a high performance graphics workstation. GRA

N88-26111# Massachusetts Univ., Amherst.
INTERMEDIATE LEVEL COMPUTER VISION PROCESSING ALGORITHM DEVELOPMENT FOR THE CONTENT ADDRESSABLE ARRAY PARALLEL PROCESSOR Quarterly Status Report No. 6, 1 Sep. - 30 Nov. 1987
Edward Riseman 29 Nov. 1987 40 p
(Contract F49620-86-C-0041)
(AD-A192086; AFOSR-88-0090TR) Avail: NTIS HC A03/MF A01 CSCL 12E

From September through November the author concentrated on the development of an Integrated Image Understanding Benchmark for computer vision architectures. Unlike previous vision benchmarks, this new benchmark is designed to test machine performance on a complete interpretation task. The task chosen will require not only that common low-level vision operations be performed, but that intermediate-level operations and interactions between operations be tested as well. In fact, the emphsis of the benchmark is on intermediate - or high-level processes controlling lower level processing in a top-down manner. The goal of the interpretation task is to recognize a modeled object in a cluttered environment. The input to the system is a set of models, any one of which may be present in the scene, and a pair of registered images. One of the images is from a black and white 8-bit intensity sensor, and the other is from a 32-bit floating-point range sensor. For the purposes of the benchmark, the images are artificially created. GRA

N88-26112 New South Wales Univ., Kensington (Australia). Dept. of Computer Science.
AUTOMATIC ROUTING IN SYMBOLIC IC DESIGN ENVIRONMENT M.S. Thesis. Abstract Only
Kwang Youn Park Mar. 1987 88 p
Avail: Issuing Activity

A heuristic algorithm for switchbox routing utilizing two layers is described. This algorithm is a grid-based routing algorithm, and assumes that all terminals are fixed on the boundary of a rectangular routing region. This algorithm is a combination of rule-based routing and conventional sequential routing, and is divided into two stages: pre-routing and maze routing. In the pre-routing stage, some of the terminals which do not significantly interfere with other terminals of different nets are connected in pre-defined patterns, and the terminals with only one direction to move are extended in the direction. In the maze-routing stage, the nets unconnected in the pre-routing stage are connected in a sequential routing algorithm. Net ordering and path selection depend on the information in the data structures expansion trees. The algorithm assigns costs to paths found, using the impact function, and selects the path with minimum cost. The algorithm was implemented in the C language, and the experimental results are quite encouraging in terms of efficiency and routing quality. Author

N88-26113# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
IDEA PROCESSING FOR CREATIVITY AND MANAGEMENT
P. E. Miller 1988 5 p Presented at the 35th Annual International Technical Communication Conference, Philadelphia, Pa., 10 May 1988
(Contract DE-AC09-76SR-00001)
(DE88-006110; DP-MS-87-163; CONF-880528-4) Avail: NTIS HC A02/MF A01

Tips and case histories on computer use for idea and outline processing are discussed. Productivity software to solve problems of idea hierarchy, transitions, and developments is matched to solutions for communicators. One case is text that ranges from methods and procedures to histories and legal definitions of classification for the US Department of Energy. Applications of value to writers, editors, and managers such as research, calendars, creativity, prioritization, idea discovery and manipulation, file and time management, and contents, indexes, and glossaries are also discussed. DOE

N88-26114# Oak Ridge National Lab., Tenn.
COMPUTER-AIDED RESEARCH
D. S. Hartley, III Mar. 1988 27 p
(Contract DE-AC05-84OR-21400)
(DE88-007771; ORNL/DSRD/TM-11) Avail: NTIS HC A03/MF A01

A computer system can be an invaluable aid to the author of a professional article by helping him to gather, maintain and use reference notes made during the literature-search phase. The researcher/author can build his own set of cross references as he goes and then retrieve those he later determines to be most relevant to his topic. As the data-base continues to grow, the system's usefulness increases. DOE

N88-26115# Brookhaven National Lab., Upton, N. Y.
EFFECTIVE COMMUNICATION BETWEEN A MICROVAX AND A SPECIALIZED HIGH-SPEED SUBPROCESSOR
H. D. Sweely and Hong Wang Jan. 1988 27 p
(Contract DE-AC02-76CH-00016)
(DE88-007967; BNL-40990) Avail: NTIS HC A03/MF A01

Designing a software system that provides effective communication between two processors requires consideration of many factors. For this project, these factors are divided into two fundamental groups: system requirements; and experimental requirements. This design note describes each of these areas, first in general, then in system specific terms. The general description intends to illustrate what is traditionally required to build a system of this type. This is useful during both planning and engineering states. The system specific description provides users of the FASTRUN system with a technical depiction of the communication mechanisms and protocol. DOE

N88-26116# Lawrence Livermore National Lab., Calif.
GRAPHICAL MULTIPROCESSING ANALYSIS TOOL (GMAT)
Mark K. Seager, Susan Campbell, Scott Sikora, Robert Strout, and Mary Zosel Mar. 1988 47 p
(Contract W-7405-eng-48)
(DE88-008019; UCID-21348; ISCR-87-2) Avail: NTIS HC A03/MF A01

The design and debugging of parallel programs is a difficult task due to the complex synchronization and data scoping issues involed. To aid the programmer in parallel code development we have developed two methodologies for the graphical display of execution of parallel codes: the Graphical Multiprocessing Analysis Tools (GMAT) consist of stategraph, which represents an inheritance tree of task states, and timeline, which represents task as flowing sequence of events. Information about the code can be displayed as the application runs (dynamic mode) or played back with time under user control (static mode). This document discusses the design and user interface issues involved in developing the parallel application display GMAT family. Also, we present an introductory user's guide for both tools. DOE

N88-26117# Argonne National Lab., Ill.
PORTABLE IMPLEMENTATION OF A GENERIC EXPONENTIAL FUNCTION IN ADA
Ping Tak Peter Tang Feb. 1988 33 p
(Contract W-31-109-eng-38)
(TI88-007699; ANL-88-3) Avail: NTIS HC A03/MF A01

By presenting a provably accurate implementation of the exponential function, it is illustrated that an accurate and portable elementary-function library can be implemented in Ada. DOE

N88-26118 Technische Hogeschool, Delft (Netherlands). Onderafdeling der Wiskunde en Informatica.
EFFICIENT PARALLEL ALGORITHM FOR THE CONNECTED COMPONENT PROBLEM AND ITS IMPLEMENTATION ON THE DPP84 (DELFT PARALLEL PROCESSOR)
F. Peper 1986 19 p
(PB87-225959; Rept-86-41) Avail: NTIS HC E03/MF E01; copy not available from STI Facility CSCL 09B

An algorithm is described for determining the connected components of a simple undirected graph with n nodes using O(n) time and n processors. It requires a Shared Memory SIMD model permitting simultaneous reading from the same memory location by different processors (read conflicts). Its implementation on the DPP 84 (the Delft Parallel Processor) and related problems are described. Author

N88-26119*# Alabama Univ., Tuscaloosa. Dept. of Electrical Engineering.
AN INTELLIGENT PROCESSING ENVIRONMENT FOR REAL-TIME SIMULATION
Chester C. Carroll and Buren Earl Wells, Jr. May 1988 189 p
(Grant NAG8-093)
(NASA-CR-183056; NAS 1.26:183056; BER-Rept-426-17) Avail: NTIS HC A09/MF A01 CSCL 09B

The development of a highly efficient and thus truly intelligent processing environment for real-time general purpose simulation of continuous systems is described. Such an environment can be created by mapping the simulation process directly onto the University of Alamba's OPERA architecture. To facilitate this effort, the field of continuous simulation is explored, highlighting areas in which efficiency can be improved. Areas in which parallel processing can be applied are also identified, and several general OPERA type hardware configurations that support improved simulation are investigated. Three direct execution parallel processing environments are introduced, each of which greatly improves efficiency by exploiting distinct areas of the simulation process. These suggested environments are candidate architectures around which a highly intelligent real-time simulation configuration can be developed. Author

N88-26120# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
CHECKOUT SYSTEM SOFTWARE FOR INPE SATELLITES
Francisco E. C. Viola, Davi T. Fernandes, Mario J. C. Ciurria, S. Stephany, H. H. Sawame, Maria C. A. Amorim, and Ana R. Benatti May 1988 7 p In PORTUGUESE; ENGLISH summary Presented at the Integrated Hardware-Software Seminar (SEMISH 88), Rio de Janeiro, Brazil, Jul. 1988
(INPE-4554-PRE/1297) Avail: NTIS HC A02/MF A01

This project was developed in the context of the first Brazilian space mission by the Integration and Test Laboratory (LIT) and the Associated Laboratory for Mathematical and Applied Computation (LAC) at the Instituto de Pesquisas Espaciais (INPE) at Sao Jose dos Campos. The Checkout System software constitutes a tool, that interposed between the test engineer and the electrical and electronical subsystems under test, processes the flow of information and commands during the integration and test phases. The information acquired by the computer is properly treated, checked, and translated in real time. The main requirements of this tool concerns three aspects: the automatic checking mechanisms, an interactive programming power and mechanisms to implement data synthesis and high level graphic presentation of the satellite subsystem status. Author

N88-26121*# Integrated Systems, Inc., Santa Clara, Calif.
AUTOMATION TOOLS FOR DEMONSTRATION OF GOAL DIRECTED AND SELF-REPAIRING FLIGHT CONTROL SYSTEMS Final Contractor Report
A. K. Agarwal Aug. 1988 77 p
(Contract NAS2-12588)
(NASA-CR-179433; H-1498; NAS 1.26:179433) Avail: NTIS HC A05/MF A01 CSCL 09B

The coupling of expert systems and control design and analysis techniques are documented to provide a realizable self repairing flight control system. Key features of such a flight control system are identified and a limited set of rules for a simple aircraft model are presented. Author

N88-26122# Oak Ridge National Lab., Tenn.
AN EXTENSION OF THE HOPFIELD-TANK MODEL FOR SOLUTION OF THE MULTIPLE TRAVELING SALESMEN PROBLEM
E. Wacholder, J. Han, and R. C. Mann 1988 20 p Presented at the IEEE Annual International Conference on Neural Networks, San Diego, Calif., 24 Jul. 1988
(Contract DE-AC05-84OR-21400)
(DE88-008377; CONF-880745-3; CONF-880745) Avail: NTIS HC A03/MF A01

We developed an efficient neural network algorithm for solving the Multiple Traveling Salesmen Problem (MTSP). A new transformation of the N-city, M-salesmen MTSP to the standard Traveling Salesmen Problem (TSP) is introduced. The transformed problem is represented by an expanded version of Hopfield-Tank's neuromorphic city-position map with (N + M - 1)-city and a single fictitious salesman. The dynamic model associated with the problem is based on the Basic Differential Multiplier Method (BDMM). The algorithm was successfully tested on many problems with up to 30 cities and 5 salesmen. In all test cases, the algorithm always converged to valid solutions. DOE

N88-26123# Los Alamos National Lab., N. Mex.
HYBRID SIMULATIONS
K. B. Quest 1987 7 p Presented at the International School for Space Simulations, La Londe les Maures, France, 15 Jun. 1987
(Contract W-7405-eng-36)
(DE88-009125; LA-UR-88-1276; CONF-8706150-2) Avail: NTIS HC A02/MF A01

The philosophy and numerical implementation of hybrid algorithms are reviewed. In the hybrid approximation, a plasma is described by a set of discrete equations, equivalent to a Vlasov-fluid system. The dynamics of one or more species are modeled using moment equations, while the remaining species are treated as a

large number of individual macro-particles. In this paper the hybrid method will be compared to fluid and particle-in-cell algorithms, and the strengths and weaknesses of the various methods will be discussed. A specific limit of the hybrid model, that of macro-particle ions and massless, charge-neutralizing fluid electrons, will be analyzed in detail with particular emphasis on multi-dimensional codes. DOE

N88-26124# Los Alamos National Lab., N. Mex.
DISTRIBUTED MATHEMATICS IN A HETEROGENEOUS ENVIRONMENT
J. R. Campbell 1987 14 p Presented at the Network Computing Forum, San Jose, Calif., 18 Nov. 1987
(Contract W-7405-eng-36)
(DE88-009128; LA-UR-88-1259; CONF-8711142-2) Avail: NTIS HC A03/MF A01

The advent of sophisticated window and operating system tools during the past several years has made it possible to provide user interfaces that are not as card- or line-oriented as previous interfaces. In addition, networking software has made it possible to distribute work among several computers so that optimal use is made of existing facilities. The computer Research and Application Group at Los Alamos National Laboratory uses these tools to access, control, and animate solutions to mathematical algorithms and to provide a simplified interface to large mathematical documentation databases. A mouse-driven menu system provides access to these documentation databases. Mathematical routines have been distributed between Sun Microsystems workstations and CRAY XMP Supercomputers. Control of these algorithms is accomplished by using windows and panels that control input to computational modules executing on the Cray. These modules return solutions to the workstation in real time. The solutions are then animated by using standard graphics. Evolution of time-dependent problems can be viewed by buffering solution data through the memory of the workstation. DOE

N88-26125# Los Alamos National Lab., N. Mex.
PHOTODIGITIZE: A SOFTWARE/HARDWARE SYSTEM
A. Silva, M. Rangel, and R. F. Hoeberling May 1988 9 p
(Contract W-7405-eng-36)
(DE88-009575; LA-11272-MS) Avail: NTIS HC A02/MF A01

PHOTODIGITIZE is an automated photo interpretation and documentation system to digitize and process single voltage waveforms captured within photographs. It has been especially designed for the ultra fast data records. This system first captures the information from the photograph onto a 512 X 512 pixel digital record and then uses recognition algorithms to identify the voltage waveform and graticule. The software was designed to be as stand-alone (small computer) and as user friendly (menu, prompt, query, etc.) as possible and to minimize operator time. DOE

N88-26126# Lawrence Livermore National Lab., Calif.
GAUSSIAN TECHNIQUES ON SHARED-MEMORY MULTIPROCESSORS M.S. Thesis - California Univ.
G. A. Darmohray Apr. 1988 105 p
(Contract W-7405-eng-48)
(DE88-010594; UCRL-53863) Avail: NTIS HC A06/MF A01

The performance characteristics of numerical algorithms running on single processor computers are well understood in terms of operation count and vectorization. When examining algorithm performance on a shared-memory multiprocessor one must consider, in addition to operation count and vectorization, the effects of processor synchronization, serial sections, memory access conflicts, and load imbalances. In this thesis the performance of Gauss and Gauss-Jordan elimination on a shared-memory multiprocessor is considered. Because real multiprocessors with appropriately pipelined functional units and suitably large numbers of processors are not yet available, the Cerberus multiprocessor simulator is used to evaluate algorithm performance. A general purpose synchronization strategy using barriers to satisfy data dependencies is commonly used in parallel algorithms. The barrier requires that processors wait for all other processors to arrive before execution is continued. Barrier synchronization can be used to satisfy most data dependencies, but in many cases is more than is needed. A key result of this work is that a custom synchronization strategy which explicitly exploits data dependencies of the Gauss elimination algorithm can outperform the generic barrier synchronization strategy without special hardware support for synchronization operations. When one is studying algorithms for multiprocessors, the traditional operation count analysis can be a poor predictor of performance. An algorithm which might be a poor performance choice on a single-processor vector architecture might become the star performer on a multiprocessor. Another result of this work is that Gauss-Jordan elimination, which has an operation count 50 percent greater than Gauss elimination, can perform better than the latter algorithm as the number of processors is increased for a fixed problem size. DOE

N88-26127*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE DEVELOPMENT OF AN INTELLIGENT INTERFACE TO A COMPUTATIONAL FLUID DYNAMICS FLOW-SOLVER CODE
Anthony D. Williams [1988] 23 p Prepared for presentation at the Symposium on Advances and Trends in Computational Structural Mechanics and Fluid Dynamics, Washington, D.C., 17-19 Oct. 1988; sponsored in part by George Washington Univ. and Langley Research Center
(NASA-TM-100908; E-4160; NAS 1.15:100908) Avail: NTIS HC A03/MF A01 CSCL 09B

Researchers at NASA Lewis are currently developing an 'intelligent' interface to aid in the development and use of large, computational fluid dynamics flow-solver codes for studying the internal fluid behavior of aerospace propulsion systems. This paper discusses the requirements, design, and implementation of an intelligent interface to Proteus, a general purpose, 3-D, Navier-Stokes flow solver. The interface is called PROTAIS to denote its introduction of artificial intelligence (AI) concepts to the Proteus code. Author

N88-26128# California Univ., Berkeley. Lawrence Berkeley Lab.
RAGS (REALTIME ACQUISITION AND GRAPHICS SYSTEM): AN OFF-THE-SHELF HARDWARE AND SYSTEM SOFTWARE SMALL DATA ACQUISITION COMPUTER
R. G. Leres Dec. 1987 5 p
(Contract DE-AC03-76SF-00098)
(DE88-008399; LBL-24808) Avail: NTIS HC A02/MF A01

A family of small, functionally comprehensive CAMAC based data acquisition systems has been developed to support experimenters whose requirements are not always compatible with available acquisition systems. Distinguishing features of these systems are their commercially built computer and CAMAC hardware, and the FORTRAN-77 programming language environment they provide to the user. These RAGS (Realtime Acquisition and Graphics System) units are most appropriate when the user is not able to support the development of original or one of a kind hardware or software for data acquisition. DOE

N88-26129# Waterloo Univ. (Ontario). Dept. of Computer Science.
QR FACTORIZATION OF A DENSE MATRIX ON A HYPERCUBE MULTIPROCESSOR
E. Chu and A. George 10 Feb. 1988 52 p Prepared in cooperation with ORNL, Tenn.
(Contract DE-AC05-84OR-21400)
(DE88-009187; ORNL/TM-10691) Avail: NTIS HC A04/MF A01

In this article we describe a new algorithm for computing the QR factorization of a rectangular matrix on a hypercube multiprocessor. The scheme involves the embedding of a two-dimensional grid in the hypercube network. We employ a global communication scheme which uses redundant computation to maintain data proximity, and the mapping strategy is such that for a fixed number of processors the processor idle time is small and

either constant or grows linearly with the dimension of the matrix. A complexity analysis tells us what the aspect ratio of the embedded grid should be in terms of the shape of the matrix and the relative speeds of communication and computation. Numerical experiments performed on an Intel Hypercube multiprocessor support the theoretical results. DOE

N88-26130# Sandia National Labs., Albuquerque, N. Mex.
LOGIC AND FAULT SIMULATION ON THE MACH1000 HARDWARE ACCELERATOR
P. Hofstadler Mar. 1988 196 p
(Contract DE-AC04-76DP-00789)
(DE88-009794; SAND-88-0609) Avail: NTIS HC A09/MF A01

This document describes an interface between Mentor Graphics brand workstations and the Mach1000 simulation accelerator from Silicon Solutions (Zycad) Corp. It discusses logic and fault simulation concepts, system administration, simulation models, hierarchical fault reporting, and hierarchical fault analysis. The tools that are presented perform simulations (MX), report fault simulation results hierarchically (Fault/Analyze), and schedule jobs to share the Mach1000 (SSD). In addition, a method of hierarchical fault analysis is developed that allows the user to determine whether a fault is undetectable or at best possibly detectable (divergent). The tools that implement the hierarchical fault analysis method are also presented. Numerous example problems are worked throughout to clarify and demonstrate the concepts that are being discussed. DOE

N88-26131# Sandia National Labs., Albuquerque, N. Mex.
GRAPHICS MANAGER (GFXMGR): AN INTERACTIVE GRAPHICS SOFTWARE PROGRAM FOR THE ADVANCED ELECTRONICS DESIGN (AED) GRAPHICS CONTROLLER, MODEL 767
D. A. Faculjak Mar. 1988 42 p
(Contract DE-AC04-76DP-00789)
(DE88-010370; SAND-88-0605) Avail: NTIS HC A03/MF A01

GRAPHICS MANAGER (GFXMGR) is menu-driven, user-friendly software designed to interactively create, edit, and delete graphics displays on the Advanced Electronics Design (AED) graphics controller, Model 767. The software runs on the VAX family of computers and has been used successfully in security applications to create and change site layouts (maps) of specific facilities. GFXMGR greatly benefits graphics development by minimizing display-development time, reducing tedium on the part of the user, and improving system performance. It is anticipated that GFXMGR can be used to create graphics displays for many types of applications. DOE

N88-26132# California Univ., Berkeley. Lawrence Berkeley Lab.
AN INSTRUMENT CONTROL AND DATA ANALYSIS PROGRAM FOR NMR IMAGING AND SPECTROSCOPY
M. S. Roos, R. A. Mushlin, E. Veklerov, J. D. Port, C. Ladd, and C. G. Harrison Jan. 1988 30 p Presented at the 5th Annual Meeting of the Society of Magnetic Resonance in Medicine, Montreal, Quebec, 19 Aug. 1986 Prepared in cooperation with International Business Machines Corp., Armonk, N.Y.
(Contract DE-AC03-76SF-00098)
(DE88-007377; LBL-24707; CONF-8608216-1) Avail: NTIS HC A03/MF A01

We describe a software environment created to support real-time instrument control and signal acquisition as well as array-processor based signal and image processing in up to five dimensions. The environment is configured for NMR imaging and in vivo spectroscopy. It is designed to provide flexible tools for implementing novel NMR experiments in the research laboratory. Data acquisition and processing operations are programmed in macros which are loaded in assembled from to minimize instruction overhead. Data arrays are dynamically allocated for efficient use of memory and can be mapped directly into disk files. The command set includes primitives for real-time control of data acquisition, scalar arithmetic, string manipulation, branching, a file system and vector operations carried out by an array processor. DOE

N88-25631# National Aerospace Lab., Tokyo (Japan).
ON THE NAL NUMERICAL SIMULATOR SYSTEM
Hajime Miyoshi and Masahiro Fukuda *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 1-11 In JAPANESE; ENGLISH summary Original contains color illustrations (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

N88-25666# Tokyo Metropolitan Univ. (Japan). Coll. of Aeronautical Engineering.
THEORY OF NUMERICAL INFORMATION ENVIRONMENT AND ITS APPLICATIONS
Masayuki Hatakeyama *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 255-259 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N88-26133 New South Wales Univ., Kensington (Australia). Dept. of Computer Science.
THE HIGH SPEED LOCAL AREA NETWORK Abstract Only. M.S. Thesis
Krerkchai Thongnoo May 1987 102 p
Avail: Issuing Activity

The hardware and implementation of a high speed ring network is described. The experimental local area computer network was designed and built. The main objective is to establish a high data rate communication link for distributed computing development and high speed transfer of picture data between workstations. The network consists of a number of VMEbus based workstations attached to the ring network via network interface units. Data are transferred between workstations in the form of a 129 bit packet with 96 bits of information field. A message from a workstation is partitioned into 12 bytes of data to fit in the information field in a packet. Simple protocols are implemented in hardware to improve the performance while the complex protocols are left for software implementation. The prototype is in operation with raw data rates up to 32 Mb/s. The measured effective data rate (including hardware protocols) is around 1.7 MByte/s, this figure is smaller with higher layer software protocols included. To achieve higher data rates, the proper packaging technique must be considered. Author

N88-26134# Helsinki Univ. of Technology, Espoo (Finland).
STRUCTURAL PROPERTIES OF MULTIVARIABLE LINEAR SYSTEMS
Dec. 1987 91 p
(PB88-181375; ISBN-951-754-324-7; RR-4) Avail: NTIS HC A05/MF A01 CSCL 09B

Some parameter-independent structural properties of multivariate linear systems are studied and used to develop analysis and synthesis methods. The structural information is expressed mainly using the controllability and observability Hermite and Kronecker indices. A structured system is defined as a dynamics system where the parameters of its state-space representation are either fixed at zero or independent and nonfixed. It is shown that for structured systems there exist generic lists of Hermite and Kronecker indices, i.e. lists which are actual index lists for almost all non-fixed parameter values. Thus the indices are shown to depend on the structure rather than on the parameter values of the system. New, more general results are found for the relations between the indices and a polynomial matrix representation by introducing the augmented indices to express the information of the uncontrollable and the unobservable modes, too. GRA

N88-26135*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REPORT ON THE SECOND CATALOG INTEROPERABILITY WORKSHOP
James R. Thieman and Mary E. James (Science Applications Research, Lanham, Md.) Apr. 1988 37 p Workshop held at Greenbelt, Md., 12-14 Jan. 1988
(NASA-TM-100701; NAS 1.15:100701) Avail: NTIS HC A03/MF A01 CSCL 09B

The events, resolutions, and recommendations of the Second Catalog Interoperability Workshop, held at JPL in January, 1988, are discussed. This workshop dealt with the issues of standardization and communication among directories, catalogs, and inventories in the earth and space science data management environment. The Directory Interchange Format, being constructed as a standard for the exchange of directory information among participating data systems, is discussed. Involvement in the Interoperability effort by NASA, NOAA, ISGS, and NSF is described, and plans for future interoperability considered. The NASA Master Directory prototype is presented and critiqued and options for additional capabilities debated. Author

N88-26136# Lawrence Livermore National Lab., Calif.
ON THE IMPLEMENTATION OF APPLICATIVE ON SHARED-MEMORY, MIMD MULTIPROCESSORS
Ching-Cheng Lee, S. Skedzielewski, and J. Feo 13 Jan. 1988 18 p Presented at the Computing Machinery Sigplan Symposium: Experience with Applications, Languages and Systems, New Haven, Conn., 19 Jul. 1988
(Contract W-7405-eng-48)
(DE88-005367; UCRL-97980; CONF-880731-1) Avail: NTIS HC A03/MF A01

This paper presents the performance of a set of algorithms written in SISAL and run on multiprocessor Sequent, VAX, and Cray computers. The current runtime system is described and its implementation on each machine discussed. We indicate where our automatic approach to parallelization works well, as well as sources of inefficient behavior. Overall we find systems adequate but immature. We suggest improvements to the compiler and runtime systems, many already developed but not yet implemented, to alleviate the inefficiencies. DOE

N88-26137# Argonne National Lab., Ill.
MVS (MULTIPLE VIRTUAL STORAGE) BATCH COMPUTING AND DATA MANAGEMENT AT ANL
M. M. Thommes, A. R. Hinds, and D. J. Thom Feb. 1988 198 p
(Contract W-31109-eng-38)
(DE88-007342; ANL/TM-400-Rev-1) Avail: NTIS HC A09/MF A01

This manual describes the batch computing system running under MVS (Multiple Virtual Storage) on the IBM computers (two IBM 3033's) at Argonne National Laboratory. It serves as a guide to the Argonne MVS batch computing environment and recommends practices and modes of operation. It explains the terminology and conventions used at Argonne, describes some Job Control Language (JCL) needed to run your MVS batch jobs, and shows how to manage data files on disk and tape devices. DOE

N88-26138# Argonne National Lab., Ill.
PERFORMANCE EVALUATION FOR MULTIPROCESSORS PROGRAMMED USING MONITORS
B. J. Lucier 1988 15 p Presented at the Association for Computing Machinery (ACM) Sigmetrics Conference, Santa Fe, N. Mex., 24 May 1988
(Contract W-31-109-eng-38)
(DE88-010056; CONF-8805102-1) Avail: NTIS HC A03/MF A01

We present a classification of synchronization delays inherent in multiprocessor systems programmed using the monitor paradigm. This characterization is useful in relating performance of such systems to algorithmic parameters in subproblems such as domain decomposition. This approach is applied to a parallel, adaptive grid code for solving the equations of one-dimensional gas dynamics implemented on shared memory multiprocessors such as the Encore Multimax. DOE

N88-26139# Oak Ridge National Lab., Tenn.
A MIXED-MODEM SOLUTION FOR SENSITIVE DATA SEGREGATION ON A BROADBAND NETWORK
R. I. Crutcher and P. D. Ewing 1988 12 p Presented at the DOE Computer Security Group Conference, Kansas City, Mo., 3 May 1988
(Contract DE-AC05-84OR-21400)
(DE88-001765; CONF-880551-1) Avail: NTIS HC A03/MF A01

Data isolation is required in broadband networks to prevent unauthorized access to the sensitive data of other users. Isolation can be obtained by using equipment from different manufacturers to introduce incompatibility between nonassociated users. This paper develops the basis for isolation and postulates that four layers of isolation will exist when the proper equipment is chosen. An experimental broadband local area network (LAN) was constructed to verify isolation. This independent test system allowed variations to network operating conditions without causing interference to normal broadband operations. The measured results indicate that a broadband LAN can transmit data of varying sensitivity levels without compromising data security. When combined with the proper administrative restrictions, the mixed-modem technique provides a cost-effective method of sharing a broadband network while maintaining isolation of data having different sensitivities. DOE

N88-26140# Naval Postgraduate School, Monterey, Calif.
FAULT DIAGNOSIS IN DISTRIBUTED COMPUTER NETWORKS M.S. Thesis
Ibrahim Dincer Dec. 1987 75 p
(AD-A192406) Avail: NTIS HC A04/MF A01 CSCL 12H

This thesis introduces the concept of a diagnosis algorithm in the context of the Preparata-Metze-Chien (PMC) model. It represents a Computer-Aided-Design (CAD) tool for use in analyzing such algorithms. That is, with this tool, the user can establish a multiprocessor system, a set of test outcomes and then analyze the properties of specified distributed diagnosis algorithm. Examples in this thesis include a system in which: (1) Correct diagnosis is achieved in a small number of iterations. (2) Correct diagnosis is never achieved. (3) An oscillating situation exits in which, faulty processors become alternately enabled and disabled. GRA

N88-25667# Fujitsu Ltd., Kawasaki (Japan).
CELLULAR ARRAY PROCESSOR (CAP) AND ITS APPLICATION TO COMPUTER GRAPHICS
Hiroyuki Sato, Kouichi Murakami, Morio Ikesaka, Hiroaki Ishihata, and Mitsuo Ishii *In* National Aerospace Lab., Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 261-269 In JAPANESE; ENGLISH summary Original contains color illustrations (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N88-26141# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
AN EXPERT SYSTEM MODEL USING PREDICATE TRANSITION NETS
Didier M. Perdu and Alexander H. Levis Jan. 1988 20 p
(Contract N00014-85-K-0782)
(AD-A191953; LIDS-P-1736) Avail: NTIS HC A03/MF A01 CSCL 12E

A Predicate Transition Net model of expert systems with fuzzy logic is proposed as a means for dealing with uncertainty. Attention is focused on consultant expert systems which use the production rules formalism to represent knowledge. Models of the basic fuzzy logical operators are presented base on the Predicate Transition Nets formalism. The combination of these operators allows to represent the links among the rules of a knowledge base and to simulate dynamically the behavior of an expert system in its search for a solution to a problem in its domain to expertise. Finally, two applications of this model are described: Assessment of parallelism in a knowledge base and the evaluation of time-related measures for expert systems. GRA

N88-26142 Yale Univ., New Haven, Conn.
STABLE DISCRETE-TIME ADAPTIVE CONTROL Ph.D. Thesis
Tong-Heng Lee 1987 180 p
Avail: Univ. Microfilms Order No. DA8729099

The problem of stable adaptive control of a linear-time-invariant plant when no external disturbances are present was resolved in 1980. This case is termed the ideal case and requires assumptions on the plant that are quite restrictive and not generally valid in practice. The stability of adaptive control systems under assumptions that are practically more reasonable is therefore a subject of considerable importance. Some of the issues involved in this subject in the adaptive control of discrete-time plants are examined, and forms part of a systematic research program at Yale aimed at developing a theory of adaptive control valid under reasonable practical assumptions. In particular, globally stable discrete-time adaptive control is shown to be possible without any prior knowledge on the high-frequency gain of the plant; the role of the degree of persistent excitation of the reference signal in assuring global stability for adaptive control in the presence of bounded external disturbances is resolved for the case of plants of arbitrary degree; the condition for globally stable adaptive control of time-varying plants are established; and a unified treatment is presented for modified adaptive laws that results in globally stable adaptive control of a class of discrete-time plants that are only partially modeled. Dissert. Abstr.

N88-26143 Rensselaer Polytechnic Inst., Troy, N.Y.
ADAPTIVE RESIDUAL MODE FILTER CONTROL OF DISTRIBUTED PARAMETER SYSTEMS FOR LARGE SPACE STRUCTURE APPLICATIONS Ph.D. Thesis
Jang James Ouyang 1987 129 p
Avail: Univ. Microfilms Order No. DA8729317

Modal control is often proposed as a way to design stabilizing low order controllers for Distributed Parameter Systems (DPS). However, it is well known that such controllers, designed from a reduced order modal model, do not necessarily stabilize the actual DPS. It is proved that exponential closed-loop stability can always be achieved by the addition of a very low order Residual Mode Filter (RMF). Due to the uncertainty of modal data for the Large Space Structure (LSS), a real-time adaptive controller was designed and tested successfully via computer simulation. The controller, implemented in a digital minicomputer, consists of a modal Reduced-Order Model (ROM) controller, a bank of RMFs, and a bank of Frequency Locked Loops (FLLs) with associated bandpass filters for real-time parameter identification. Three DPS examples: a simply supported Euler-Bernoulli beam, a telegraph equation, and a Space Based Laser (SBL) beam expander are presented to illustrate the application of this concept. Dissert. Abstr.

N88-26144*# Indiana Univ.-Purdue Univ., Lafayette. Engineering Div.
MODEL REDUCTION METHODS FOR CONTROL DESIGN Final Contractor Report
K. R. Dunipace Aug. 1988 140 p
(Contract NCC2-289)
(NASA-CR-179434; H-1499; NAS 1.26:179434) Avail: NTIS HC A07/MF A01 CSCL 09B

Several different model reduction methods are developed and detailed implementation information is provided for those methods. Command files to implement the model reduction methods in a proprietary control law analysis and design package are presented. A comparison and discussion of the various reduction techniques is included. Author

N88-25626# Joint Publications Research Service, Arlington, Va.
APPLICATION OF AI TO SPACE SYSTEMS
In its JPRS Report: Science and Technology. Japan 4 May 1988 p 55-58 Transl. into ENGLISH from Kogiken Nyusu (Tokyo, Japan), Jan. 1988 p 8-10 (For primary document see N88-25619 19-31)
Avail: NTIS HC A06/MF A01

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N88-26145# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
SOLUTION OF FADDEEV-YAKUBOVSKY DIFFERENTIAL EQUATIONS BY THE FINITE-DIMENSIONAL APPROXIMATION METHOD FOR FOUR SPINLESS PARTICLES IN THE 1+3 SCATTERING PROBLEM
V. B. Belyaev, V. I. Kochkin, and O. I. Kartavtsev 1986 10 p In RUSSIAN; ENGLISH summary
(DE87-702983; JINR-R-4-86-573) Avail: NTIS (US Sales Only)HC A02/MF A01

By means of the method of finite-dimensional approximation of the differential operator in Yakubovsky equations the problem of determining the length of 1+3 scattering for the four spinless particles is investigated. The pair potential of the Gaussian type was applied in the calculations. The scattering length was found to be a sub (4) = -5.88 Fm. DOE

N88-26146# Naval Ocean Systems Center, San Diego, Calif.
SLAPP: A SPECIAL MULTIPROCESSOR ARRAY FOR SIGNAL PROCESSING AND LINEAR ALGEBRA Professional Paper, period ending Aug. 1987
J. J. Symanski, Tom Henderson, Judy Shirasago, John Celto, and Barry Drake Dec. 1987 9 p
(AD-A191587) Avail: NTIS HC A02/MF A01 CSCL 12F

The key to meeting the extremely high throughput requirements of future military signal and image processing systems is parallelism in algorithms and hardware. This paper will describe the implementation of a core set of algorithms on one possible hardware implementation, designed to achieve high speed and efficient parallelism. This approach and design procedure, while using currently available integrated circuit building blocks, is similar to how this type of processor will be developed in the future using VLSI. GRA

N88-26147 Technische Hogeschool, Delft (Netherlands). Onderafdeling der Wiskunde en Informatica.
NONLINEAR CONFORMAL TRANSFORMATIONS AND CLIFFORD ALGEBRAS
J. G. Maks 1986 17 p
(PB87-225942; Rept-86-39) Avail: NTIS HC E03/MF E01; copy not available from STI Facility CSCL 12A

It is well known that the conformal group of the real orthogonal space of signature (p,q) with p+q greater than 2 is doubly covered by the orthogonal group O(p+1,q+1). The nonlinear conformal transformations may be linearized by embedding the compactified orthogonal space of signature (p,q) homogeneously in the orthogonal space of signature (p+1,q+1). Regarding the nonlinear conformal transformations themselves, there is a striking lack of general formulations in the strayed literature. The generalization of the familiar (anti-)homographies of the compactified complex plane is determined. The generalization emerges when a very special spinor representation of O(p+1,q+1)(2X2-matrices) is used for the conformal group. Author

N88-26148*# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
NON-OSCILLATORY SPECTRAL FOURIER METHODS FOR SHOCK WAVE CALCULATIONS Final Report
Wei Cai, David Gottlieb, and Chi-Wang Shu Jun. 1988 33 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-181675; ICASE-88-37; NAS 1.26:181675) Avail: NTIS HC A03/MF A01 CSCL 12A

A non-oscillatory spectral Fourier method is presented for the solution of hyperbolic partial differential equations. The method is based on adding a nonsmooth function to the trigonometric polynomials which are the usual basis functions for the Fourier method. The high accuracy away from the shock is enhanced by using filters. Numerical results confirm that no oscillations develop in the solution. Also, the accuracy of the spectral solution of the inviscid Burgers equation is shown to be higher than a fixed order. Author

N88-26149# Brookhaven National Lab., Upton, N. Y.
TWO DOMAIN DECOMPOSITION TECHNIQUES FOR STOKES PROBLEMS
J. E. Pasciak Jan. 1988 11 p
(Contract DE-AC02-76CH-00016)
(DE88-008724; BNL-41113) Avail: NTIS HC A03/MF A01

Two domain decomposition techniques for Stokes problems are developed. The first uses a reformulation of the saddle point system and reduces the derivation of domain decomposition algorithms for Stokes to the definition of domain decomposition preconditioners for second order problems. The second applies domain decomposition directly to Stokes and gives rise to a saddle point system for the velocity nodes on the subdomain boundaries and the mean values of the pressure on the subdomains. This system is solved iteratively. DOE

N88-26150# Lawrence Livermore National Lab., Calif.
COMPUTER MODELING OF TIME DEPENDENT SBS (STIMULATED BRILLOUIN SCATTERING) IN TWO AND THREE DIMENSIONS
S. M. Wandzura Feb. 1988 3 p Prepared in cooperation with Hughes Research Labs., Malibu, Calif.
(Contract W-7405-eng-48)
(DE88-008922; UCRL-21029) Avail: NTIS HC A02/MF A01

Numerical solutions of the equations satisfied by time dependent stimulated Brillouin scattering have been obtained. The results indicate that both the magnitude and conjugation fidelity of the Stokes wave fluctuate on a time scale of the order of ten phonon lifetimes. DOE

N88-26151# Los Alamos National Lab., N. Mex.
SOME SUPRACONVERGENT SCHEMES FOR HYPERBOLIC EQUATIONS ON IRREGULAR GRIDS
B. Wendroff and A. B. White, Jr. 1988 7 p Presented at the 2nd International Conference on Hyperbolic Problems, Aachen, Fed. Republic of Germany, 14 Mar. 1988
(Contract W-7405-eng-36)
(DE88-009113; LA-UR-88-1384; CONF-880392-1) Avail: NTIS HC A02/MF A01

An analysis of the truncation error for finite difference schemes frequently shows an apparent loss of accuracy when a nonuniform grid is used. Some schemes exhibit the phenomenon of supraconvergence, that is, there is no loss of accuracy in the global error. We show that this is the case for smooth solutions of the color equation for an upstream conservative scheme, for two versions of the Lax-Wendroff scheme, and for a variant of the von Neumann-Richtmyer scheme for gas dynamics, if the latter three are stable. DOE

N88-26152# California Univ., Berkeley. Lawrence Berkeley Lab.
DISCONTINUOUS INVERSE STURM-LIOUVILLE PROBLEMS WITH SYMMETRIC POTENTIALS Ph.D. Thesis
Mei Kobayashi Mar. 1988 107 p
(Contract DE-AC03-76SF-00098)
(DE88-009803; LBL-24974) Avail: NTIS HC A06/MF A01

In this paper we study the inverse Sturm-Liouville problem on a finite interval with a symmetric potential function with two interior discontinuities. In the introductory chapter we survey previous results on the existence and uniqueness of solutions to inverse Sturm-Liouville problems and discuss earlier numerical methods. We present a uniqueness proof for the inverse Sturm-Liouville problem on a finite interval with a symmetric potential having two interior jump discontinuities. We show that any absolutely continuous function can be expanded in terms of the eigenfunctions of a Sturm-Liouville problem with two discontinuities. We consider two Sturm-Liouville problems with different symmetric potentials with two discontinuities satisfying symmetric boundary conditions and symmetric jump conditions. We find that if only a finite number of eigenvalues differ then a simple expression for the difference of the potentials can be established. In addition, the locations of the discontinuities are uniquely determined. Finally, we derive an algorithm for solving the discontinuous inverse Sturm-Liouville problem numerically and present the results of numerical experiments. DOE

N88-26153# Sandia National Labs., Albuquerque, N. Mex.
A DESCRIPTION OF THE REFERENCE FRAMES AND THE COORDINATE TRANSFORMATIONS USED IN AMEER (AERO-MECHANICAL EQUATIONS EVALUATIONS ROUTINES)
R. A. LaFarge 23 Mar. 1988 75 p
(Contract DE-AC04-76DP-00789)
(TI88-007960; SAND-88-0243) Avail: NTIS HC A04/MF A01

A guide to the use of AMEER (Aero-Mechanical Equations Evaluations Routines) was previously published. This report is intended to supplement the previous user's manual by analyzing in detail the reference frames in AMEER and their relationships. The coordinate transformations used in the initialization process and in the computational phase for both the six degree of freedom (6-DOF) and the point mass (PM) trajectory options are derived. Additionally, the PM equations of motion are derived. DOE

N88-26154# Oak Ridge National Lab., Tenn.
FIVE-POINT FORM OF THE NODAL DIFFUSION METHOD AND COMPARISON WITH FINITE-DIFFERENCE
Y. Y. Azmy 1988 8 p Presented at the American Nuclear Society Annual Meeting, San Diego, Calif., 12 Jun. 1988
(Contract DE-AC05-84OR-21400)
(DE88-004141; CONF-880601-3) Avail: NTIS HC A02/MF A01

Nodal Methods have been derived, implemented and numerically tested for several problems in physics and engineering. In the field of nuclear engineering, many nodal formalisms have been used for the neutron diffusion equation, all yielding results which were far more computationally efficient than conventional Finite Difference (FD) and Finite Element (FE) methods. However, not much effort has been devoted to theoretically comparing nodal and FD methods in order to explain the very high accuracy of the former. In this summary we outline the derivation of a simple five-point form for the lowest order nodal method and compare it to the traditional five-point, edge-centered FD scheme. The effect of the observed differences on the accuracy of the respective methods is established by considering a simple test problem. It must be emphasized that the nodal five-point scheme derived here is mathematically equivalent to previously derived lowest order nodal methods. DOE

N88-26155# Los Alamos National Lab., N. Mex.
THE MAFIA APPROACH TO SOLVING MAXWELL'S EQUATIONS IN THREE DIMENSIONS
R. K. Cooper, M. J. Browman, and T. Weiland 1988 11 p Presented at the 4th Annual Review of Progress in Applied Computational Electromagnetics, Monterey, Calif., 22 Mar. 1988 Prepared in cooperation with Deutsches Elektronen-Synchrotron (DESY), Hamburg, Fed. Republic of Germany
(Contract W-7405-eng-36)

(DE88-007826; LA-UR-88-978; CONF-880370-1) Avail: NTIS HC A03/MF A01

The acronym MAFIA stands for the solution of Maxwell's equations by the Finite Integration Algorithm and is the name give to a set of codes intended for use in the computer-aided design of three-dimensional magnets, RF structures, and structures in which wake-field effects are important. This paper gives a brief description of the algorithms employed in both the time- and the frequency- domain solvers of the MAFIA collection of codes. Examples of typical accelerator calculations will be presented. DOE

N88-26156# Naval Postgraduate School, Monterey, Calif.
CALCULATING THE SELF-INTERSECTIONS OF BEZIER CURVES
Dieter Lasser Mar. 1988 41 p
(AD-A192371; NPS-53-88-001) Avail: NTIS HC A03/MF A01 CSCL 12A

A user-friendly divide-and-conquer algorithm is presented for finding all the self intersection points of a parametric curve in the Bernstein-Bezier representation. The underlying idea of the algorithm is to deal with the Bezier polygon instead of the curve description itself. By alternately subdividing the Bezier polygon and estimating the self intersection regions the self intersection points are finally approximated by straight line intersections of the refined Bezier polygons. The algorithm also calculates the parameter values of the self intersection points. In addition to the convex hull and the approximation property of the Bezier polygon the working of the algorithm is based on a very intuitive angle criterion. GRA

N88-26157*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SEMI-DISCRETE APPROXIMATIONS TO NONLINEAR SYSTEMS OF CONSERVATION LAWS; CONSISTENCY AND L(INFINITY)-STABILITY IMPLY CONVERGENCE Final Report
Eitan Tadmor Jul. 1988 63 p Prepared in cooperation with Tel-Aviv Univ. (Israel) Submitted for publication
(Contract NAS1-18107; Grants BFS-85-00346; NSF DMS-85-03294)
(NASA-CR-181683; ICASE-88-41; NAS 1.26:181683) Avail: NTIS HC A04/MF A01 CSCL 12A

A convergence theory for semi-discrete approximations to nonlinear systems of conservation laws is developed. It is shown, by a series of scalar counter-examples, that consistency with the conservation law alone does not guarantee convergence. Instead, a notion of consistency which takes into account both the conservation law and its augmenting entropy condition is introduced. In this context it is concluded that consistency and L(infinity)-stability guarantee for a relevant class of admissible entropy functions, that their entropy production rate belongs to a compact subset of H(loc)sup -1 (x,t). One can now use compensated compactness arguments in order to turn this conclusion into a convergence proof. The current state of the art for these arguments includes the scalar and a wide class of 2 x 2 systems of conservation laws. The general framework of the vanishing viscosity method is studied as an effective way to meet the consistency and L(infinity)-stability requirements. How this method is utilized to enforce consistency and stability for scalar conservation laws is shown. In this context we prove, under the appropriate assumptions, the convergence of finite difference approximations (e.g., the high resolution TVD and UNO methods), finite element approximations (e.g., the Streamline-Diffusion methods) and spectral and pseudospectral approximations (e.g., the Spectral Viscosity methods). Author

N88-25658# National Aerospace Lab., Tokyo (Japan). Computational Sciences Div.
ON THE PROPAGATING SPEED IN DIFFERENCE APPROXIMATIONS FOR CONSERVATION LAWS
Hideaki Aiso *In its* Proceedings of the 5th NAL Symposium on Aircraft Computational Aerodynamics Nov. 1987 p 201-207 In JAPANESE; ENGLISH summary (For primary document see N88-25630 19-31)
Avail: NTIS HC A12/MF A01

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N88-26158# Sao Paulo Univ. (Brazil). Inst. de Fisica e Quimica de Sao Carlos.
THE POTTS MODEL IN A RANDOM FIELD
Jose F. Fontanari, W. K. Theumann, and David R. C. Dominguez (Rio Grande do Sul Univ., Porto Alegre, Brazil) [1988] 40 p
Avail: NTIS HC A03/MF A01

The q-state Potts model in a random field with a discrete distribution of statistically independent fields ordered along any of the q states is studied in mean-field theory. Detailed phase diagrams are obtained in a two-component order-parameter theory for q = 3 and a one-component theory for general q. Lines of critical and tricritical points are found in the first case and lines of critical points in the second one, in the presence of a sufficiently large constant uniform field. Author

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N88-26159# RAND Corp., Santa Monica, Calif.
THE ARMY'S ROLE IN SPACE: SUPPORT FOR THE BATTLEFIELD COMMANDER
Elwyn Harris, Richard Darilek, Kenneth Horn, and Mark Nelsen Dec. 1987 10 p
(RAND-P-7396) Avail: NTIS HC A02/MF A01

A doctrinal role for the U.S. Army in space is advocated. The concept of AirLand Battle is extended to AeroSpace Land Battle. In the battlefield environment of the future, commanders will have access to space systems that can provide enhanced communications and synchronization, navigation and meteorological information, battlefield situation assessment, and early warning and tipoff/cueing capabilities. Command and control will be enhanced through the development of space-based capabilities that will locate enemy force concentrations and dispositions. An on-demand space launch mission is envisioned. Potential future space systems with battlefield applications include battlefield probes, tipoff to commanders about such threats as incoming tactical ballistic missiles, and monitoring ground transportation assets. J.P.B.

N88-26160# Oak Ridge National Lab., Tenn.
THE OAK RIDGE NATIONAL LABORATORY STRATEGIC DEFENSE INITIATIVE SHIELD OPTIMIZATION PROGRAM
T. A. Gabriel, J. M. Barnes, B. L. Bishop, J. D. Drischler, J. O. Johnson, R. A. Lillie, R. T. Santoro, and M. S. Smith Apr. 1988 127 p
(Contract DE-AC05-84OR-21400)
(DE88-008946; ORNL/TM-10631) Avail: NTIS HC A07/MF A01

Scoping studies have been completed to estimate the radiation induced damage in silicon-based electronic components carried on a satellite. The analyses were completed for natural (Van Allen belt protons and electrons, solar flares, and galactic cosmic rays) and man-made (nuclear and directed neutral particle beam weapons) radiation expected to be encountered by an SDI satellite or weapon platform. The Van Allen belt protons, depending on altitude and orbital inclination, were found to be the most stressing natural radiation threat. Nuclear weapon radiation, depending upon the weapon yield and distance of the detonation from the satellite, and neutral particle beam radiation were found to terminally destroy

electronic components. Calculations were also made to estimate the amount of local shielding required to extend mission performance. These shields were optimized for minimum weight for specified damage thresholds. All of the calculations were carried out assuming the presence of a thin primary shield tailored specifically for survivability against an incident low mass kinetic energy weapon projectile and which affords minimal protection against energetic radiation. DOE

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N88-26161# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
DEVIATION EQUATION AS AN EQUATION OF MOTION
B. Z. Iliev 1987 11 p
(DE88-702134; JINR-E-2-87-78) Avail: NTIS (US Sales Only) HC A03/MF A01

On the basis of a noninfinitesimal deviation vector a new derivation (in spaces with the affine connection) of a generalized deviation is given for the case when the curves appearing in it, which can be geodesic as well as nongeodesic, are given implicitly (by second order differential equations). It is shown that the equations of relative motion of two point particles in spaces with the affine connection in the field of external forces are special cases of the generalized deviation equation. As examples the Euclidean case and the general infinitesimal (local) deviation equation are considered. DOE

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N88-26162# Brookhaven National Lab., Upton, N. Y.
ANOMALOUS RF MAGNETORESISTANCE IN COPPER AT 4 K
H. J. Halama, A. G. Prodell, J. T. Rogers, S. DePanfilis, A. C. Melissinos, B. E. Moskowitz, Y. K. Semertzidis, W. U. Wuensch, W. B. Fowler, and F. A. Nezrick Mar. 1988 16 p
(Contract DE-AC02-76CH-00016)
(DE88-010232; BNL-41211) Avail: NTIS HC A03/MF A01

The effect of a magnetic field on the surface resistance of polycrystalline Cu at f = 1.2 GHz and at 4.4 K is measured; under these conditions the surface resistance is well into the anomalous skin effect regime but has not reached its limiting value. It is found that the transverse and longitudinal magnetoresistance are an order of magnitude smaller than the dc magnetoresistance and depend quadratically on the field. At low fields we observe a decrease in surface resistance with increasing field which can be interpreted as a size effect of the RF surface current. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N88-26163# Naval Ocean Systems Center, San Diego, Calif.
RAY SCATTERING FROM A COLLECTION OF ICE KEELS Report, period ending May 1987
David F. Gordon Nov. 1987 15 p
(AD-A191757) Avail: NTIS HC A03/MF A01 CSCL 20A

An ice keel program that was described at the Spring 1985 meeting (paper z7) is used to investigate the acoustic scattering properties of ice keels at high frequency. Keels are modeled as parabolas. Sample sets of keels are generated using published distributions of spacing and sizes ((O.I. Diachok, J. Acocust. Soc. Am. 59, 1110-1120 (1976)). A large number of rays are directed towards the keel set and the emerging rays are collected into angular bins. Reflections from and refraction through the ice are employed. Specular reflection coefficients computed in this manner are similar to published results (ibid Diachok) above 3 deg grazing angle. No significant specular reflection is found at lower grazing angles. The scattered rays tend to be directed predominantly into angles near the specular angle. GRA

N88-26164 Rensselaer Polytechnic Inst., Troy, N.Y.
ACOUSTIC WAVE DISPERSION IN A VISCOUS, COMPRESSIBLE, LIQUID-FILLED CYLINDRICAL ELASTIC TUBE Ph.D. Thesis
Chi-Min Chang 1987 301 p
Avail: Univ. Microfilms Order No. DA8729299

One of the primary sources of intense sound radiation from piping systems arises from the so-called helical fluid modes or modes whose wavefronts form spiral patterns like a barber's pole. When the axial component of a fluid spiral mode wave velocity coincides or is near the corresponding axial component of the spiral solid wall mode, efficient coupling can occur. The dispersion relation or complex eigenvalue equation for a viscous, compressible liquid contained by an elastic, traction free cylinder subjected to steady periodic acoustic excitation is derived and solved by the method of eigenvalleys. Totally new coupling phenomena which generates hybrid modes are found and their relationship to the current theory involving the coincidence of fluid and solid axial wave numbers is presented. Dissert. Abstr.

N88-26165*# Sikorsky Aircraft, Stratford, Conn.
RESEARCH INVESTIGATION OF HELICOPTER MAIN ROTOR/TAIL ROTOR INTERACTION NOISE Final Report
J. Fitzgerald and F. Kohlhepp Washington NASA May 1988 112 p
(Contract NAS1-17126)
(NASA-CR-4143; NAS 1.26:4143) Avail: NTIS HC A06/MF A01 CSCL 20A

Acoustic measurements were obtained in a Langley 14 x 22 foot Subsonic Wind Tunnel to study the aeroacoustic interaction of 1/5th scale main rotor, tail rotor, and fuselage models. An extensive aeroacoustic data base was acquired for main rotor, tail rotor, fuselage aerodynamic interaction for moderate forward speed flight conditions. The details of the rotor models, experimental design and procedure, aerodynamic and acoustic data acquisition and reduction are presented. The model was initially operated in trim for selected fuselage angle of attack, main rotor tip-path-plane angle, and main rotor thrust combinations. The effects of repositioning the tail rotor in the main rotor wake and the corresponding tail rotor countertorque requirements were determined. Each rotor was subsequently tested in isolation at the thrust and angle of attack combinations for trim. The acoustic data indicated that the noise was primarily dominated by the main rotor, especially for moderate speed main rotor blade-vortex interaction conditions. The tail rotor noise increased when the main rotor was removed indicating that tail rotor inflow was improved with the main rotor present. Author

N88-26166*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SIMULATED MEASUREMENT OF POWER FLOW IN STRUCTURES NEAR TO SIMPLE SOURCES AND SIMPLE BOUNDARIES
Michael C. McGary Jun. 1988 68 p
(NASA-TM-89124; NAS 1.15:89124) Avail: NTIS HC A04/MF A01 CSCL 20A

Advances in electronics technology along with the advent of low cost multichannel Fast Fourier analyzers have made it practical to use higher order central difference formulas to measure power flow in 1- and 2-D structures. The method discussed uses five point differencing for the spatial derivatives in 1-D and a thirteen point difference pattern for the spatial derivatives in 2-D plates and shells. It is assumed that the measuring transducers are accelerometers. An analytical study of the higher order differencing method and the conventional two accelerometer method was performed as a preliminary to the application of these methods to

actual aircraft structures. Some classical problems were analyzed in order to simulate and compare the performance of the two methods under near field measurement conditions. These near field conditions include examples of power flows near simple sources and simple boundaries. The estimates produced by the two methods were compared to the exact solution in each example. Presented are the theory and selected results of the study, which indicate that the bias errors of the two accelerometer method under near field measurement conditions may be much larger than previous studies have suggested. Author

N88-25895# California Univ., Berkeley. Dept. of Electrical Engineering.
THIN-MEMBRANE LAMB-MODE ACOUSTIC OSCILLATORS FOR CHEMICAL DETECTION
Edward T. Zellers, Stuart W. Wenzel, Richard M. White, and Peter J. Wicher *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 4 p Sponsored in part by Chevron Research, Inc. and the State of California MICRO Project (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 20A

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N88-26167# California Univ., Berkeley. Dept. of Chemical Engineering.
PHASE EQUILIBRIA AND DENSITY CALCULATIONS IN THE CRITICAL REGION: A PHENOMENOLOGICAL CORRECTION FOR A CLASSICAL EQUATION OF STATE Annual Report, 1 Jan. - 31 Dec. 1987
G. F. Chou and J. M. Prausnitz Jan. 1988 25 p
(Contract GRI-5083-260-0953)
(PB88-185335; GRI-88/0034) Avail: NTIS HC A03/MF A01 CSCL 20H

A phenomenological procedure is proposed to correct a vdW-type classical equation of state to represent phase equilibria and densities in the critical region. The procedure consists of two corrections. The first correction enables the equation to locate the true critical point using a volume-translation technique; the volume translation is a function of the distance from the critical point. A temperature-dependence variable related to the isothermal compressibility is used to characterize this distance. The volume-translation method preserves the vapor-pressure curve predicted from the original equation; it also improves liquid-density predictions both within and outside the critical region. The second correction consists of a contribution to the residual Helmholtz energy which accounts for density fluctuations in the critical region. The near-critical correction is characterized by a distance variable similar to that used in volume translation. GRA

N88-26168# Ohio State Univ., Columbus. Dept. of Chemistry.
MOLECULAR ORBITAL STUDIES OF THE BONDING IN HEAVY ELEMENT ORGANOMETALLICS: PROGRESS REPORT
B. E. Bursten 22 Mar. 1988 24 p
(Contract DE-FG02-86ER-13529)
(DE88-007765; DOE/ER-13529/T1) Avail: NTIS HC A03/MF A01

Over the past two years we have made considerable progress in the understanding of the bonding in heavy element mononuclear and binuclear complexes. For mononuclear complexes, our strategy has been to study the orbital interactions between the actinide metal center and the surrounding ligands. One particular system which has been studied extensively is X sub 3 AnL (where X = Cp, Cl, NH sub 2 ; An = actinide; and L = neutral or anionic ligand). We are interested not only in the mechanics of the An-X orbital interactions, but also how the relative donor characteristics of X may influence coordination of the fourth ligand L to the actinide. For binuclear systems, we are interested not only in homobimetallic complexes, but also in heterobimetallic complexes containing actinides and transition metals. In order to make the calculations of such large systems tractable, we have transferred the X-alpha-SW codes to the newly acquired Cray XMP24 at the Ohio Supercomputer Center. This has resulted in significant savings of money and time. DOE

N88-26169# Brown Univ., Providence, R. I.
INTERACTIONS OF MOLECULES WITH SURFACES Progress Report, 16 Mar. 1987 - 30 Mar. 1988
E. F. Greene 1988 5 p
(Contract DE-FG02-85ER-13441)
(DE88-007950; DOE/ER-13441/4) Avail: NTIS HC A02/MF A01

Progress is reported on three projects: (1) ions formed when alkali metal atoms strikes a surface; (2) surface temperature rise when an expanding gas hits a surface; and (3) use of diffraction of He atoms to follow changes in the Si crystal surface. DOE

N88-26170# Los Alamos National Lab., N. Mex.
PRIMER ON COUPLING COLLECTIVE ELECTRONIC OSCILLATIONS TO NUCLEI
J. C. Solem, L. C. Biedenharn, Jr., and Faith J. Harp Jul. 1987 11 p
(Contract W-7405-eng-36)
(LA-10878) Avail: NTIS HC A03/MF A01

On the basis of simple heuristic models, it was shown that atomic electrons can amplify fields observed at the nucleus, generate harmonics, and drive higher multipolarities. A model with the nucleus at the focus of a uniformly charged ellipsoid was considered. It amplified an oscillating external electric field and produces an oscillating electric field gradient but no higher derivatives. The electric field has only odd harmonics and the electric-field gradient has only even harmonics. There is an optimum intensity for driving each harmonic. The relevance of these results to the U-235 experiment and to the gamma-ray laser are discussed. Author

N88-26171 Paris II Univ., Orsay (France). Lab. de l'Horloge Atomique.
EXAMINATION OF THE TERMALIZATION OF CONFINED IONS
M. Desaintfuscien Feb. 1987 53 p In FRENCH Sponsored by Direction des Recherches, Etudes et Techniques, Paris, France
(PB87-227815) Avail: NTIS HC E04/MF E04; copy not available from STI Facility CSCL 20H

The methods being developed make it possible to measure temperature in various situations which correspond to the conditions encountered in experiments of ion confinement: Paul or Penning trap, existence of a transition accessible by laser or of a microwave transition. This is being implemented to obtain data on the phenomena which disturb the kinetic energy state under these various conditions. Author

N88-26172# Lawrence Livermore National Lab., Calif.
ATOMIC PROCESSES IN MATTER-ANTIMATTER INTERACTIONS
D. L. Morgan 25 Jan. 1988 30 p Presented at the Symposium on the Production and Investigation of Atomic Antimatter, Karlsruhe, Federal Republic of Germany, 30 Nov. 1987
(Contract W-7405-eng-48)
(DE88-008911; UCRL-98127; CONF-8711176-1) Avail: NTIS HC A03/MF A01

Atomic processes dominate antiproton stopping in matter at nearly all energies of interest. They significantly influence or determine the antiproton annihilation rate at all energies around or below several MeV. This article reviews what is known about these atomic processes. For stopping above about 10 eV the processes are antiproton-electron collisions, effective at medium keV through high MeV energies, and elastic collisions with atoms and adiabatic ionization of atoms, effective from medium eV through low keB energies. For annihilation above about 10 eV is the enhancement of the antiproton annihilation rate due to the antiproton-nucleus coulomb attraction, effective around and below

a few tens of MeV. At about 10 eV and below, the atomic rearrangement/annihilation process determines both the stopping and annihilation rates. Although a fair amount of theoretical and some experimental work relevant to these processes exist, there are a number of energy ranges and material types for which experimental data does not exist and for which the theoretical information is not as well grounded or as accurate as desired. Additional experimental and theoretical work is required for accurate prediction of antiproton stopping and annihilation for energies and material relevant to antiproton experimentation and application.
DOE

N88-26173# Aerospace Corp., El Segundo, Calif. Space Sciences Lab.
OBSERVATIONS OF ELECTRON CYCLOTRON HARMONIC EMISSIONS ASSOCIATED WITH FIELD-ALIGNED ELECTRON BEAMS
H. C. Koons, J. F. Fennell, D. J. Gorney, and B. C. Edgar 1 Jul. 1987 36 p
(Contract F04701-85-C-0086; Grant NSF ATM-83-13655)
(SD-TR-87-33) Avail: NTIS HC A03/MF A01 CSCL 20H

Several cases were found in plasma wave and electron distribution function data from the SCATHA satellite in which strong gyrofrequency emissions near 1.5 times the local electron gyrofrequency correlate in time with field aligned electron beams. The energy of the electron beams ranges from 100 to 800 eV. Before the beam appears the emissions are observed at a lower frequency, typically 1.1 to 1.2 gyrofrequencies. As the beam develops, the emissions rise in frequency and grow in amplitude. Above 2 keV the electrons had a normal loss-cone distribution. This loss cone deepened by a small amount when the beams appeared at lower energy. These observations were made near local midnight between L=7.0 and 7.9 R sub e. Author

N88-26174# Houston Univ., Tex. Dept. of Chemistry.
INELASTIC ION-SURFACE COLLISIONS Scientific Report No. 1
J. W. Rabalais 15 May 1987 19 p
(Contract F19628-86-K-0013)
(AFGL-TR-87-0206) Avail: NTIS HC A03/MF A01 CSCL 20H

Ion scattering and direct recoil spectrometries were used to investigate electronic excitation and charge transfer processes occurring during rare gas ion bombardment of CuLi alloy. Excitations in the close encounter appear to be governed by the degree of inner shell mixing between the colliding pair. Excitations in the outgoing trajectory are governed by the probabilities of Auger and resonant charge exchange between the scattered or recoiled particle and the surface. Measurements of the vacuum ultraviolet photon emission of the scattered and recoiled particles proved to be unsuccessful due to low photon yields. The ion induced surface damage to transition metal fluoroanions was investigated by XPS and UPS. Ion bombardment reduces the transition metal atom to lower oxidation states, in some cases all the way to the metal. These results are consistant with the thermal spike model of ion damage. Author

N88-26175# Rice Univ., Houston, Tex.
THEORETICAL ATOMIC AND MOLECULAR PHYSICS Progress Report, 1 Jul. 1987 - 30 Jun. 1988
N. F. Lane 29 Feb. 1988 12 p
(Contract DE-FG05-87ER-13751)
(DE88-007122; DOE/ER-13751/1) Avail: NTIS HC A03/MF A01

In this first year of the grant, emphasis has been placed on theoretical investigations of: differential elastic and charge-transfer scattering and alignment and orientation of the excited electron cloud in ion-atom, atom-atom and ion-molecule collisions, using a molecular-orbital representation; quenching of low-lying Rydberg states of a Na atom in a collision with a ground-state He atom, using a semiclassical representation; chemiionization and ion-pair formation in a collision of a Li atom with a metastable He atom at intermediate collision energies, using a combination of quantal and semi-classical methods; Penning ionization of alkali atoms K and Rb, using advanced CI and Stieltjes imaging methods; radiative and nonradiative charge-transfer in He(+) + H collisions at ultra-low collision energies, using quantal methods; charge-transfer in ion-atom, ion-molecule, and ion-surface-atom collisions at intermediate energies, using semi-classical methods; and elastic and inelastic processes in electron-molecule collisions, using the continuum-multiple-scattering (CMS) method. Selected highlights of the research progress are briefly summarized in the following sections.
DOE

N88-26176# Sandia National Labs., Albuquerque, N. Mex.
EXPERIMENTS ON INSULATION OF RELATIVISTIC ELECTRON FLOWS IN OBLIQUE AND TAPERED MAGNETIC FIELDS
C. W. Mendel, Jr., J. P. Quintenz, S. E. Rosenthal, D. B. Seidel, R. Coats, and M. E. Savage 1988 3 p Presented at the 13th International Symposium on Discharges and Electrical Insulation in Vacuum, Paris, France, 27 Jun. 1988 Prepared in cooperation with New Mexico Univ., Albuquerque
(Contract DE-AC04-76DP-00789)
(DE88-007199; SAND-88-0026C; CONF-880687-1) Avail: NTIS HC A02/MF A01

Several experiments on magnetically insulated electron flows will be reported. These include experiments in combined axial and azimuthal magnetic fields like those seen in powerful ion diodes, and flows in which the degree of insulation is changed along the flow path. Conservation of transverse electron canonical momentum implies that the flows cannot be exactly in the ExB direction. Measurements of the field pitch (the ratio of the axial to the azimuthal magnetic field) show a tendency to flow in the ExB direction with very little current along the magnetic field. However, it was also found that the flow tended to find an equilibrium where electrons in ExB flow have only small transverse canonical momentum. Other data show a surprising degree of electron recapture at the cathode under some conditions. This has important implications for multi-terrawatt devices.
DOE

N88-26177# Kansas State Univ., Manhattan. Dept. of Physics.
ATOMIC PHYSICS OF STRONGLY CORRELATED SYSTEMS
C. D. Lin 1987 3 p Presented at the DOE/BES Atomic Physics Program Workshop, Cambridge, Mass., 21 May 1987
(Contract DE-FG02-86ER-13596)
(DE88-007789; DOE/ER-13596/12; CONF-870595-3) Avail: NTIS HC A02/MF A01

This report summarizes the progress made in our study of strongly correlated systems since the last DOE/BES Atomic Physics Program Workshop and addresses our future plans. The report is divided into two parts: the study of electron correlations and the classification of multiply excited states of atoms; the theoretical study of charge transfer processes in ion-atom collisions.
DOE

N88-26178# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.
HALF COLLISION STUDIES OF INELASTIC ENERGY TRANSFER PROCESSES
M. I. Lester 1988 19 p
(Contract DE-FG02-87ER-13792)
(DE88-008096; DOE/ER-13792/1) Avail: NTIS HC A03/MF A01

A new method is being developed for exploring inelastic collisional energy transfer events. These experiments rely on examining the unimolecular dissociation dynamics of OH-Rg vdW (Van der Waals) complexes in the Chi squared Pi and Alpha squared Sigma (+) states. The inelastic half collision transfers vibrational (and/or rotational) excitation, initially localized in OH internal motions, to translational recoil of the separating fragments and rotational excitation of OH. The collision partners start at close range and separate along the same potential energy surface sampled in full collisions. The complete determination of the internal state distribution of the products will allow the potential energy surface for the OH-rare gas interaction to be fully defined. The nascent rotational state distribution of the OH fragment is expected

to reflect the final interaction between OH and the rare gas atom. Comparisons will be made between full and half collision dynamics in both the Chi and Alpha states. DOE

N88-26179# California Univ., Berkeley. Lawrence Berkeley Lab.
MULTIPLY STRIPPED ION GENERATION IN THE METAL VAPOR VACUUM ARC
I. G. Brown, B. Feinberg, and J. E. Galvin Sep. 1987 32 p
(Contract DE-AC03-76SF-00098)
(DE88-008418; LBL-21999-Rev) Avail: NTIS HC A03/MF A01

We consider the charge state distribution of ions produced in the metal vapor vacuum arc plasma discharge. A new kind of high current metal ion source in which the ion beam is extracted from a metal vapor vacuum arc plasma has been used to obtain the spectra of multiply charged ions produced within the cathode spots. The cathode materials used and the species reported on here are: C, Mg, Al, Si, Ti, Cr, Fe, Co, Ni, Cu, Zn, Zr, Nb, Mo, Rh, Pd, Ag, In, Sn, Gd, Ho, Ta, W, Pt, Au, Pb, Th, and U; the arc current was 200 A for all measurements. Charge state spectra were measured using a time-of-flight method. The arc voltage was also measured. In this paper we report on the measured charge state distributions and arc voltages and compare the distributions with the predictions of a theory in which ionization occurs in the cathode spots via stepwise ionization by electron impact. DOE

N88-26180# Stanford Linear Accelerator Center, Calif.
ELECTRON-POSITRON PHYSICS AT 1 TeV
G. J. Feldman Mar. 1988 24 p Presented at the 8th Vanderbilt High Energy Physics Conference, Nashville, Tenn., 8 Oct. 1987
(Contract DE-AC03-76SF-00515)
(DE88-009019; SLAC-PUB-4564; CONF-871071-3) Avail: NTIS HC A03/MF A01

We discuss the motivation for TeV e(+) e(-) linear colliders, some aspects of their design, and the experimental consequences that follow from the design. After a brief discussion of the general physics environment, we consider the discovery potential of these colliders by examining three sample processes: the detection of new heavy leptons, standard Higgs bosons, and charged Higgs bosons. DOE

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N88-26181# Sandia National Labs., Albuquerque, N. Mex.
RUTHERFORD MAGNETIC SPECTROGRAPH FOR INTENSE ION BEAM MEASUREMENTS ON PBFA 2
R. J. Leeper, W. A. Stygar, R. P. Kensek, J. R. Lee, D. J. Johnson, T. R. Lockner, J. Maenchen, D. E. Hebron, and D. F. Wenger 1988 15 p Presented at the 7th Topical Conference on High Temperature Plasma Diagnostics, Napa, Calif., 13 Mar. 1988
(Contract DE-AC04-76DP-00789)
(DE88-007281; SAND-87-3120C; CONF-880364-1) Avail: NTIS HC A03/MF A01

A time-resolved magnetic spectrograph employing a gold Rutherford scattering foil has been constructed to measure the parameters of the intense ion beams generated by Sandia National Laboratories' PBFA-2 accelerator. The spectrograph operates by allowing the direct intense beam of PBFA 2 to scatter from a thin gold foil to reduce its intensity for magnetic analysis. Details of the spectrograph's construction, detector package and recent PBFA-2 proton data are included in the paper. DOE

N88-26182# California Univ., Berkeley. Lawrence Berkeley Lab. Accelerator and Fusion Research Div.
HIGH DOSE URANIUM ION IMPLANTATION INTO SILICON
I. G. Brown, J. E. Galvin, and K. M. Yu May 1987 16 p
(Contract DE-AC03-76SF-00098)
(LBL-23509) Avail: NTIS HC A03/MF A01

Implantation of uranium ions into silicon to a maximum dose of 6 x 10 to the 16th atoms/sq cm, with a maximum concentration of 6 x 10 to the 21th atoms/cu cm, was performed. This concentration corresponds to 12 atomic percent of uranium in the silicon host material. The implanted uranium content was measured by Rutherford backscattering and confirmed by a measurement of the alpha-particle acitivity of the buried uranium layer. The range and straggling of the uranium, and sputtering of the silicon targets by uranium, were measured and compared with theoretical estimates. The implantation was performed at an ion mean energy of 157 keV using a high current metal ion source. Author

N88-26183# California Univ., Berkeley. Lawrence Berkeley Lab. Accelerator and Fusion Research Div.
HEAVY ION FUSION SYSTEM ASSESSMENT: FINAL FOCUS AND TRANSPORT MODEL
V. O. Brady, A. Faltens, D. Keefe, E. P. Lee, and J. Hovingh (Lawrence Livermore National Lab., Calif.) Jul. 1987 21 p
(Contract DE-AC03-76SF-00098)
(LBL-23040) Avail: NTIS HC A03/MF A01

The required small spot size on the pellet is met by low specified emittance, small momentum spread, and a set of other focal and reactor constraints which are only partially understood at present. The convergence cone half-angle, theta, is set at a value which is determined by tradeoffs among economic and physical factors. Factors driving a low value of theta are dispersion, aberrations, magnet costs, reactor economics, shielding and beamline vacuum. Factors driving a large value of theta are the emittance limit, space charge limits, and jitter control. The typical range of reactor values (theta = 5-20 mr) is the result of compromise among these factors. Aside from the spot size condition, it is desired to make the normalized emittance relatively large (epsilon sub n = beta gamma epsilon greater than 1/100,000 m-r) since transportable current is found to vary as epsilon sub n to the 2/3 power, and too small a value of epsilon sub n could result in an unreasonably large number of beamlets in the high energy portion of the linac (N increasing above approximately 24). Author

N88-26184 Science Research Council, Chilton (England). Rutherford Appleton Lab.
MECHANISMS FOR PARTICLE ACCELERATION: POSSIBILITIES AND CONSTRAINTS
J. D. Lawson Mar. 1987 10 p Presented at the 1987 Particle Accelerator Conference, Washington, D.C., Mar. 1987
(PB88-102538; RAL-87-016) Avail: NTIS HC E03/MF E03; copy not available from STI Facility CSCL 20H

An attempt is made to classify schemes that are used, or have been proposed, for accelerating particles. The basis for classification is the fundamental nature of the field-particle interaction; the photon viewpoint is introduced into the classical description normally used by accelerator designers. Author

N88-26185*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ACCURACY OF ANALYTIC ENERGY LEVEL FORMULAS APPLIED TO HADRONIC SPECTROSCOPY OF HEAVY MESONS
Forooz F. Badavi, John W. Norbury (Washington State Univ., Pullman.), John W. Wilson, and Lawrence W. Townsend Jul. 1988 26 p Sponsored by NASA, Washington
(NASA-TM-4042; L-16434; NAS 1.15:4042) Avail: NTIS HC A03/MF A01 CSCL 20H

Linear and harmonic potential models are used in the nonrelativistic Schroedinger equation to obtain article mass spectra for mesons as bound states of quarks. The main emphasis is on the linear potential where exact solutions of the S-state eigenvalues and eigenfunctions and the asymptotic solution for the higher order partial wave are obtained. A study of the accuracy of two analytical energy level formulas as applied to heavy mesons is also included. Cornwall's formula is found to be particularly accurate and useful as a predictor of heavy quarkonium states. Exact solution for all

partial waves of eigenvalues and eigenfunctions for a harmonic potential is also obtained and compared with the calculated discrete spectra of the linear potential. Detailed derivations of the eigenvalues and eigenfunctions of the linear and harmonic potentials are presented in appendixes. Author

N88-26186# California Univ., Los Angeles. School of Engineering and Applied Science.
REFLEX: AN ENERGY DEPOSITION CODE THAT MODELS THE EFFECTS OF ELECTRON REFLECTION DURING ELECTRON BEAM HEATING TESTS
C. A. Stone, IV, C. D. Croessmann, and J. B. Whitley Jan. 1988 137 p Prepared in cooperation with Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE88-009789; SAND-87-1954) Avail: NTIS HC A07/MF A01

This report describes an energy coupling model that considers electron reflection losses during electron beam heating experiments. This model is embodied on the REFLEX computer code, written in standard FORTRAN 77. REFLEX currently models energy deposition phenomena in three different sample geometries. These configurations include flat, cylindrical shell, and hemispherical shell surfaces. Given the electron beam operating parameters, REFLEX calculates the heat flux profile over a sample's surface, the total amount of energy deposited into a sample, and the percentage of the electron beam energy that is transferred to a sample. This document describes the energy deposition equations used in the REFLEX code; the program is described and detailed instructions are given regarding the input. Results are given for each geometry and possible experimental applications are presented. DOE

N88-26187# Maryland Univ., College Park.
ACCELERATOR RESEARCH STUDIES Annual Technical Report
Mar. 1988 150 p
(Contract DE-AC05-85ER-40216)
(DE88-008236; DOE/ER-40216/5-Rev) Avail: NTIS HC A07/MF A01

This paper discusses accelerator research at the University of Maryland. The three task studies contained in this paper are: Instabilities and Emittance Growth in Periodic Focusing Systems for Intense Beams; Collective Ion Acceleration by Intense Electron Beams and Pulse Powered Plasma Focus; and Microwave Sources and Parameter Scaling for High-Frequency Supercollider Linacs. DOE

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N88-26188# Helsinki Univ. of Technology, Espoo (Finland). Dept. of Technical Physics.
ANALYTICAL DESCRIPTION OF NOISE IN PHASE-CONJUGATE RESONATORS
A. T. Friberg and R. Salomaa 1987 40 p
(PB88-171947; TKK-F-A622; ISBN-951-754-339-5) Avail: NTIS HC A03/MF A01 CSCL 20F

An analytical method is derived for the evaluation of the average conjugate and specular reflections of a probe field from a phase-conjugate resonator. Statistical fluctuations described by Poissonian sudden jumps may simultaneously occur in the amplitude and phase of both the probe field and the complex reflectivity of the phase-conjugate mirror. In the possible noise scenarios, any mixture of phase and amplitude jump probabilities can be included. The resonator is assumed to stay in the stable regime. It is shown that phase fluctuations have the strongest influence on the resonator performance. Amplitude noise is important only if jumps are infrequent and the resonator operates close to the instability threshold or the phase-conjugate mirror reflectivity is about unity. GRA

N88-26189# Helsinki Univ. of Technology, Espoo (Finland). Electromagnetics Lab.
PETURBATIONAL ANALYSIS OF THE CURVED ANISOTROPIC OPTICAL FIBER FOR THE BIREFRINGENCE DUE TO THE GEOMETRY
M. Oksanen Oct. 1987 33 p
(PB88-171848; ISBN-951-754-291-7; Rept-18) Avail: NTIS HC A03/MF A01 CSCL 20F

Birefringence, due to a uniform bending of an anisotropic optical fiber, is studied. The analysis is perturbational and valid only for large radii of curvature. First, the theory is given to a general inhomogeneous weakly guiding anisotropic waveguide leading to second-order differential vector equations for the transversal fields and a formula for the change of the propagation constant. This is seen to be of the order of (a/(R sub 0)) squared, where a is the radius of the fiber and (R sub 0) is the radius of the curvature. Next, the concept of LP-modes in the weakly-guiding fiber is adopted, and the analysis is applied to isotropic step-index and parabolic-index fibers together with the corresponding anisotropic waveguides. Field solutions and expressions for the birefringence are discussed in each of the cases. GRA

N88-26190*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INFLUENCE OF REFRACTIVE INDEX AND SOLAR CONCENTRATION ON OPTICAL POWER ABSORPTION IN SLABS
M. D. Williams Jul. 1988 11 p Sponsored by NASA, Washington
(NASA-TM-4056; L-16442; NAS 1.15:4056) Avail: NTIS HC A03/MF A01 CSCL 20F

The optical power absorbed by a slab at the focus of a parabolic dish concentrator is calculated. The calculations are plotted versus maximum angle of incidence of irradiation (which corresponds to solar concentration) with absorption coefficient as a parameter for several different indices of refraction that represent real materials. Author

N88-26191# Sandia National Labs., Albuquerque, N. Mex.
A HIGH DYNAMIC RANGE ACOUSTO-OPTIC IMAGE CORRELATOR FOR REAL-TIME PATTERN RECOGNITION
P. A. Molley and K. T. Stalker 1988 11 p Presented at the SPIE's Technical Symposium on Optics, Electro-optic and Sensors, Orlando, Fla., 4 Apr. 1988
(Contract DE-AC04-76DP-00789)
(DE88-007933; SAND-88-0860C; CONF-880462-5) Avail: NTIS HC A03/MF A01

The architecture and experimental results for an incoherent acousto-optic image correlator suitable for real-time applications are presented. In the basic architecture, each time a line of the raster scanned input image is fed into the acousto-optic device (AOD), all rows of a digitally stored reference image are read into the system using an array of Light Emitting Diodes (LED's). Thus, the required two-dimensional correltaion is performed as a series of multi-channel 1-D time-integrations in x (performed in the AOD) combined with a multi-channel correlation in y (perpendicular to the AOD axis) using a modified CCD. The LED array and detector modifications which markedly increase the dynamic range are discussed as well as correlator design. Further, a novel memory for storing the reference object is described for rapidly changing templates. Experimental results indicate the architecture is useful for applications in the areas of character recognition and target identification. DOE

N88-26192# Lawrence Livermore National Lab., Calif.
LASER INDUCED SURFACE EMISSION OF NEUTRAL SPECIES AND ITS RELATIONSHIP TO OPTICAL SURFACE DAMAGE PROCESSES
L. L. Chase and L. K. Smith 2 Mar. 1988 37 p Presented at the Boulder Damage Symposium, Boulder, Colo., 26 Oct. 1987
(Contract W-7405-eng-48)
(DE88-008035; UCRL-98431; CONF-8710165-11) Avail: NTIS HC A03/MF A01

The laser-induced emission of neutral constituents and impurities from surfaces of several optical materials is shown to be correlated with optical surface damage thresholds. The characteristics of the emission can be utilized to investigate physical processes involved in the absorption of laser energy at the surface. Examples are given of neutral emission correlated with catastrophic surface heating, changes in surface stoichiometry, and thermally-induced cracking. DOE

N88-26193*# Wisconsin Univ., Madison. Cooperative Inst. for Meteorological Satellite Studies.
METEOROLOGICAL SATELLITE PRODUCT SUPPORT AND RESEARCH FOR PROJECT GALE Final Report, 1 Oct. 1985 - 14 Apr. 1988
Christopher S. Velden, William L. Smith, Thomas H. Achtor, and W. Paul Menzel Jun. 1988 35 p
(Grant NAG5-742)
(NASA-CR-180989; NAS 1.26:180989) Avail: NTIS HC A03/MF A01 CSCL 20F

This participation in the Genesis of Atlantic Lows Experiment (GALE) focused on three main areas: (1) real-time support of the field phase, centered on a McIDAS workstation; (2) satellite data collection, archive, product generation, and dissemination; and (3) research into satellite rainfall estimation and data assimilation. Accomplishments include production of a videotape of animated GOES satellite imagery, production of an atlas of GOES satellite imagery, production of a set of 12-hour interval analyses; research into 4-D data assimilation, and production of a set of satellite-estimated rainfall maps. J.P.B.

N88-26194# California Univ., Berkeley. Lawrence Berkeley Lab. Accelerator and Fusion Research Div.
BEVALAC EXTERNAL BEAMLINE OPTICS
J. G. Kalnins, G. F. Krebs, M. M. Tekawa, and J. R. Alonso Apr. 1987 142 p
(Contract DE-AC03-76SF-00098)
(LBL-23240) Avail: NTIS HC A07/MF A01

This handbook is intended as an aid for tuning the external particle beam (EPB) lines at the Lawrence Berkeley Laboratory's Bevalac. First, general information is given concerning the EPB lines and beam optics. Next, each beam line is described in detail: schematics of the beam line components are shown; all the variables required to run a beam transport program are presented; and beam envelopes are given with wire chamber pictures and magnet currents, focal points and magnifications. Some preliminary scaling factors are then presented which should aid in choosing a given EPB magnet's current for a given central Bevalac field. Finally, some tuning hints are suggested. Author

N88-26195# Northwestern Univ., Evanston, Ill. Dept. of Physics and Astronomy.
X-RAY AND OPTICAL ANALYSIS OF SURFACE PROPERTIES OF METAL OPTICS
Y. Matsui, M. P. Ulmer, and P. Z. Takacs 1987 7 p Presented at the 31st SPIE Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering, San Deigo, Calif., 16 Aug. 1987 Prepared in cooperation with Brookhaven National Lab., Upton, N.Y.
(Contract DE-AC02-76CH-00016)
(DE88-004033; BNL-41040; CONF-8708110-34) Avail: NTIS HC A02/MF A01

We replicated by electroforming grazing incidence Wolter type I mirrors for 7-keV X-rays from two superpolished mandrels. Optical profiler measurements on both the masters and mirrors were made to understand the ability of the replication technique and to understand the X-ray reflecting performance of the mirrors. To directly determine the performance of the mirrors, single mirrors and a nested pair were tested with a near-parallel beam of 1.5 and 6.4 keV X-rays that filled the opening aperture of the optics. We found that the FWHM's of their point spread functions were less than approximately 20 arcsec and total effective areas were approximately greater than 70 percent of the theoretical values. We also compared X-ray results with optical profiler measurements by use of a computer code. We found that the X-ray measurements are consistent with predictions made from the optical measurements and the computer code. Based on this, the surface microroughness requirements necessary to achieve a half power diameter less than 1.5 arcmin for 7 keV X-rays are a high-frequency roughness less than 14 A and a mid-frequency roughness less than 70 A for our 25 arcmin grazing incidence optics. DOE

N88-25802# Naval Research Lab., Washington, D.C.
PICOSECOND OPTICAL AUTOCORRELATION EXPERIMENTS ON FAST PHOTODETECTORS
T. F. Carruthers and J. F. Weller *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 121-123 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25819# Bell Telephone Labs., Inc., Holmdel, N. J.
OPTICAL MODULATION ABOVE 20 GHz USING A WAVEGUIDE ELECTROOPTIC SWITCH
S. K. Korotky, G. Eisenstein, R. S. Tucker, J. J. Veselka, and G. Raybon *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 179-181 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25871# Sandia National Labs., Albuquerque, N. Mex. Microsensor Div.
OPTICAL SENSING OF MAGNETIC FIELDS
M. A. Butler and S. J. Martin *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 20F

N88-26051# Institut Francais de Recherche pour l'Exploitation de la Mer, Brest (France).
UNDERWATER OPTICAL TRAJECTOGRAPHY AND VIDEO IMAGE MOSAICS [TRAJECTOGRAPHIE OPTIQUE SOUS-MARINE ET MOSAIQUES D'IMAGES VIDEO]
J.-M. Augustin, J. M. Boucher, P. Boutherny, J.-P. Hue, and G. Loaec *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 251-255 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N88-26196# Army Lab. Command, Watertown, Mass. Material Technology Lab.
NONLINEAR OPTICAL PROPERTIES AND SUBPICOSECOND DYNAMICS OF EXCITONS AND ELECTRON-HOLE PLASMAS IN MULTIPLE QUANTUM WELL STRUCTURES Final Report, Jul. 1984 - Oct. 1987
T. F. Boggess, A. L. Smirl, R. A. MacFarlene, and J. F. Lam Dec. 1987 209 p
(Contract F49620-84-C-0083)
(AD-A191926; HAC-REF-F4767; AFOSR-88-0012TR) Avail: NTIS HC A10/MF A01 CSCL 20L

This report describes progress in measuring and modeling the nonlinear optical properties of and picosecond carrier dynamics in bulk ternary alloys and Multiple Quantum Wells (MQWs). Studies of the bulk alloy Al(x)Ga(1-x)As have been produced the first experimental isolation of the electron exchange energy in a dense electron-hole plasma, and the observation of enhanced band-gap renormalization as a consequence of alloy disorder, stimulated emission from the indirect gap for x-values as large as 0.52, and large optical nonlinearities from band filling, band-gap renormalization, and screening of the excitonic continuum states. The latter appear promising for room temperature absorptive and

dispersive optical bistability. An exact theory of the influence of an intense radiation field on the excitonic energy levels of a MQW has been developed and has led to the prediction of two-wave mixing gain. GRA

N88-26197# Lawrence Livermore National Lab., Calif.
PROPERTIES OF HYDROGEN/HELIUM ACCRETION PLASMAS
N. Guessoum and C. D. Dermer Feb. 1988 7 p Presented at the Workshop on Nuclear Spectroscopy of Astrophysical Sources, Washington, D.C., 14 Dec. 1987 Prepared in cooperation with California Univ., San Diego, La Jolla
(Contract W-7405-eng-48)
(DE88-006831; UCRL-98254; CONF-871245-4) Avail: NTIS HC A02/MF A01

We study the properties of impulsively-heated plasmas initially composed of hydrogen and helium. We follow the time-dependent behavior of the ion and electron temperatures, the pair density, and the densities of hydrogen, helium, and nuclei formed in fusion and breakup reactions. We also consider neutron production and escape, and calculate the 0.431 and 0.478 MeV line luminosities from alpha-alpha fusion reactions, and the 2.22 MeV line luminosity from neutron capture on protons. DOE

N88-26198# Sandia National Labs., Albuquerque, N. Mex.
LASER MEASUREMENT OF PARTICLE VELOCITIES IN VACUUM PLASMA SPRAY DEPOSITION
M. F. Smith 1988 10 p Presented at the 1st Plasma-Technik Symposium, Lucerne, Switzerland, 18 May 1988
(Contract DE-AC04-76DP-00789)
(DE88-007111; SAND-77-2283C; CONF-880576-1) Avail: NTIS HC A02/MF A01

The velocity of spray particles in vacuum plasma spray deposition affects particle residence time in the plasma, heat transfer from the plasma to the particles, and the kinetic energy upon impact with the target surface. Hence, particle velocity is an important process variable which influences particle melting as well as the density and adhesion of the deposited material. A laser velocimeter system has been used to investigate the effects of variations in process parameters on particle velocities in a vacuum plasma spray system. The results reveal significant relationships between particle velocity and process parameters such as spray particle size, particle mass density, spray chamber pressure, plasma arc power, and electrode geometry. Conversely, over the range of conditions studied, particle velocity was relatively insensitive to changes in plasma gas supply rate, plasma gas composition, and power feed rate. DOE

N88-26199# Sandia National Labs., Albuquerque, N. Mex.
PHOTOCONDUCTING X-RAY DETECTORS FOR Z-PINCH EXPERIMENTS
R. B. Spielman, W. W. Hsing, and D. L. Hanson Mar. 1988 15 p Presented at the 7th Topical Conference on High Temperature Plasma Diagnostics, Napa, Calif., 13 Mar. 1988
(Contract DE-AC04-76DP-00789)
(DE88-007118; SAND-87-3035C; CONF-880364-9) Avail: NTIS HC A03/MF A01

GaAs and GaAs:Cr photoconducting detectors (PCDs) are used to measure the absolute x-ray output from 1-10 keV from Z-pinch radiation sources. The detectors were calibrated over the spectral range of 900 eV to 3000 eV and the spectral response found to be constant to within the accuracy of the measurements. The flat spectral response, increased sensitivity (compared with bolometers), and good time response of the PCDs, coupled with their reliability and long lifetimes, have allowed us to acquire absolute x-ray data of significantly higher quality than possible with resistive bolometers or x-ray diodes (XRDs). An added attraction of PCDs is their smooth saturation at high incident x-ray fluxes. Unlike other types of electrical x-ray detectors, this feature allows a PCD to operate over a wide range of incident x-ray powers (10x10 to the 4th W/sq cm. Results are presented from gas puff Z-pinch experiments on Proto-2 and SuperMITE comparing PCD, XRD, and resistive bolometer performance. DOE

N88-26200# Sandia National Labs., Albuquerque, N. Mex.
THE XRD (X-RAY DIODE) ARRAY, THE GRAZING INCIDENCE SPECTROMETER AND THE X-RAY IMAGING CAMERA ON PBFA 2
M. S. Derzon, M. A. Sweeney, P. Grandon, H. C. Ives, R. P. Kensek, L. P. Mix, and W. A. Stygar 1988 17 p Presented at the 7th Topical Conference on High Temperature Plasma Diagnostics, Napa, Calif., 13 Mar. 1988
(Contract DE-AC04-76DP-00789)
(DE88-007282; SAND-87-3125C; CONF-880364-3) Avail: NTIS HC A03/MF A01

Target diagnostics on PBFA 2 will include a time-resolved x-ray diode array, an energy-resolved, time-integrated x-ray camera and a grazing incidence spectrometer. A clean vacuum, independent of that on PBFA 2, will be supplied to the detectors to maintain more reproducible calibrations. We also describe the diagnostics and outline the calculations which determined the shielding required. Based on the calculations the background due to bremsstrahlung in the least sensitive diagnostic is 12 eV/pixel. The appropriate shielding is being built to field these diagnostics. DOE

N88-26201# North Carolina Univ., Asheville. Dept. of Physics.
DESIGN AND CALIBRATION OF A TWO-CHANNEL LOW-NOISE HETERODYNE RECEIVER FOR USE IN A CO2 LASER THOMSON SCATTERING ALPHA PARTICLE DIAGNOSTIC
C. A. Bennett, R. K. Richards, and D. P. Hutchinson Mar. 1988 17 p Prepared in cooperation with ORNL, Tenn.
(Contract DE-AC05-84OR-21400)
(DE88-007866; ORNL/TM-10419) Avail: NTIS HC A03/MF A01

A dual channel low noise heterodyne receiver has been constructed as part of a development effort to build a carbon dioxide laser based Thomson scattering alpha particle diagnostic for a burning plasma experiment. The receiver employs two wide bandwidth (greater than 1 GHz) HgCdTe photovoltaic mixers followed by low noise IF amplifiers. A noise equivalent power of less than 3.0 times 10 to the 20th power WHz has been demonstrated. Design details and calibration methods are described. DOE

N88-26202# KMS Fusion, Inc., Ann Arbor, Mich.
SIMULTANEOUSLY TIME- AND SPACE-RESOLVED SPECTROSCOPIC CHARACTERIZATION OF LASER-PRODUCED PLASMAS
G. Charatis, B. K.F. Young, G. E. Busch, C. J. Cerjan, W. H. Goldstein, A. L. Osterheld, T. W. Phillips, M. D. Rosen, R. E. Stewart, and R. S. Walling 3 Mar. 1988 7 p Presented at the SPIE O-E Lase '88: Optoelectronics and Laser Applications in Science and Engineering, Los Angeles, Calif., 10 Jan. 1988 Prepared in cooperation with Lawrence Livermore National Lab., Calif. and California Univ., Davis
(Contract W-7405-eng-48)
(DE88-008038; UCRL-98386; CONF-880110-26) Avail: NTIS HC A02/MF A01

The CHROMA laser facility at KMS Fusion has been used to irradiate a variety of microdot targets. These include aluminum dots and mixed bromine dots doped with K-shell (magnesium) emitters. Simultaneously time- and space-resolved K-shell and L-shell spectra have been measured and compared to dynamic model predictions. The electron density profiles are measured using holographic interferometry. Temperatures, densities, and ionization distributions are determined using K-shell and L-shell spectral techniques. Time and spatial gradients are resolved simultaneously using three diagnostics: a framing crystal X-ray spectrometer, an X-ray streaked crystal spectrometer with a spatial imaging slit, and a 4-frame holographic interferometer. Significant differences have been found between the interferometric and the model-dependent spectral measurements of plasma density. Predictions by new non-stationary L-shell models currently being developed are also presented. DOE

N88-26203# General Atomic Co., San Diego, Calif.
A LOW DIVERGENCE, HIGH BRIGHTNESS LITHIUM ION SOURCE FOR PLASMA DIAGNOSTICS
D. M. Thomas, W. P. West, and K. McCormick Feb. 1988 13 p Presented at the 7th Topical Conference on High Temperature Plasma Diagnostics, Napa, Calif., 13 Mar. 1988 Prepared in cooperation with Max-Planck-Institut fuer Plasmaphysik, Garching, West Germany
(Contracts DE-AC03-84ER-53158; DE-AC03-84ER-51044)
(DE88-008063; GA-A-19216; CONF-880364-20) Avail: NTIS HC A03/MF A01

Plasma diagnostics employing lithium beams are in routine use on several present-day tokamak experiments. These measurements are constrained by the availability of a suitable lithium ion source. Necessary and/or desireable parameters include narrow energy spread, high emission current density, simplicity, and long lifetime. The existing ion gun on the TEXT experiment uses the thermionic emitter beta-eucryptite and meets the above requirements, except for being limited to a useful emission of about 4 mA. We will present design criteria and accelerator results for a new ion gun capable of 15 mA emission based on an increased emitter area. Important design considerations are the thermal and mechanical properties of the large (approximately 20 square cm) emitter area and the ion optics required to focus the emitted flux into a beam of approximately 1 square cm cross section. The potential improvement in the performance of both the TEXT and ASDEX diagnostic systems will be discussed. DOE

N88-26204# Oak Ridge National Lab., Tenn.
ANALYSIS OF PLASMA COUPLING WITH THE PROTOTYPE DIII-D ICRF ANTENNA
P. M. Ryan, D. J. Hoffman, T. S. Bigelow, F. W. Baity, W. L. Gardner, M. J. Mayberry, and K. E. Rothe 1988 4 p Presented at the 15th European Conference on Controlled Fusion and Plasma Heating, Dubrovnik, Yugoslavia, 16 May 1988
(DE88-008085; CONF-880534-2) Avail: NTIS HC A02/MF A01

Coupling to plasma in the H-mode is essential to the success of future ignited machines such as CIT. To ascertain voltage and current requirements for high-power second harmonic heating (2 MW in a 35- by 50-cm port), coupling to the DIII-D tokamak with a prototype compact loop antenna has been measured. The results show good loading for L-mode and limiter plasmas, but coupling 2 MW to an H-mode plasma demands voltages and currents near the limit of present technology. The technological analysis and progress that allow coupling of these power densities are reported. DOE

N88-26205# General Atomic Co., San Diego, Calif.
THE SAFETY DESIGNS FOR THE TITAN REVERSED-FIELD PINCH REACTOR STUDY
C. P. C. Wong, S. P. Grotz, J. Blanchard, E. T. Cheng, S. Sharafat, R. L. Creedon, C. G. Hoot, F. Najmabadi, and K. R. Schultz Mar. 1988 12 p Presented at the International Symposium on Fusion Nuclear Technology, Tokyo, Japan, 10 Apr. 1988 Prepared in cooperation with California Univ., Los Angeles
(Contract DE-AC03-84ER-53158)
(DE88-008169; GA-A-19238; CONF-880417-7) Avail: NTIS HC A03/MF A01

TITAN is a study to investigate the potential of the reversed-field pinch concept as a compact, high-power density energy system. Two reactor concepts were developed, a self-cooled lithium design with vanadium structure and an aqueous solution loop-in-pool design, both operating at 18 MWm^2. The key safety features of the TITAN-1 lithium-vanadium blanket design are in material selection, fusion power core configuration selection, lithium piping connections and passive lithium drain tank system. Based on these safety features and results from accident evaluation, TITAN-1 can at least be rated as level 3 of safety assurance. For the TITAN-2 aqueous loop-in-pool design, the key passive feature is the complete submersion of the fusion power core and the corresponding primary coolant loop system into a pool of low temperature water. Based on this key safety design feature, the TITAN-2 design can be rated as level 2 of safety assurance. DOE

N88-26206# Oak Ridge National Lab., Tenn.
THE JET (JOINT EUROPEAN TORUS) MULTIPELLET LAUNCHER AND FUELING OF JET PLASMAS BY MULTIPELLET INJECTION
S. L. Milora, G. L. Schmidt, T. C. Jernigan, L. R. Baylor, S. K. Combs, W. A. Houlberg, D. Schissel, P. Colestock, G. Hammett, and M. Zarnstorff et al. 1988 4 p Presented at the 15th European Conference on Controlled Fusion and Plasma Heating, Dubrovnik, Yugoslavia, 16 May 1988 Prepared in cooperation with Joint European Torus Project, Abingdon, United Kingdom
(Contract DE-AC05-84OR-21400)
(DE88-008367; CONF-880534-3; CONF-880534) Avail: NTIS HC A02/MF A01

A new multipellet long-pulse plasma fueling system is in operation on (Joint European Torus) JET. In the initial experimental phase, a variety of plasma density profile shapes have been produced with peak to average values ranging up to 2.5 and peak plasma density up to 1.2 times 0.001 m. DOE

N88-26207# International Centre for Theoretical Physics, Trieste (Italy).
ELECTRON-ACOUSTIC WAVES IN A BEAM-PLASMA SYSTEM
M. Y. El-Ashry and R. N. El-Sherief Jul. 1987 8 p
(DE88-702053; IC-87/166) Avail: NTIS (US Sales Only) HC A02/MF A01

The instability of the electron-acoustic wave in a beam-plasma system, in which the plasma consists of an admixture of hot and cold electrons, is investigated. New types of hydrodynamics and kinetic instabilities have been found. DOE

N88-26208# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ION THERMAL CONDUCTIVITY AND ION DISTRIBUTION FUNCTION IN THE BANANA REGIME
Masayoshi Taguchi Apr. 1988 15 p
(IPPJ-865; ISSN-0469-4732) Avail: NTIS HC A03/MF A01

A new approximate collision operator which is more general than the model operator derived by Hirshman and Sigmar is presented. By use of this collision operator, the ion thermal conductivity and the ion distribution function in the banana regime are calculated for an axisymmetric toroidal plasma of arbitrary aspect ratio. In the limits of large and small aspect ratios, the computed thermal conductivity agrees with the results of Rosenbluth et al. and Hazeltine et al. The simple expression for this conductivity is also derived. Author

N88-26209# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ECRH CURRENT DRIVE IN TOKAMAK PLASMAS
Masayoshi Taguchi Apr. 1988 29 p
(IPPJ-864; ISSN-0469-4732) Avail: NTIS HC A03/MF A01

The current drive by electron cyclotron resonance heating (ECRH) is investigated in a typical magnetic field of tokamak with circular cross section. The trapped electrons and the modification of electron-cyclotron resonance condition by the relativistic mass increase are shown to have significant effects on the efficiency of this current drive. The efficiency strongly depends on the values of the parallel velocity of resonant electrons, the inverse aspect ratio, the poloidal angle of absorption point, and the relativistic parameter which represents the strength of the relativistic correction to the resonance condition. Author

N88-26210 California Univ., Irvine.
CALCULATION OF THE LINE SHAPES OF RADIATORS IMMERSED IN PLASMA Ph.D. Thesis
Alek Savad Hayrapetian 1987 140 p
Avail: Univ. Microfilms Order No. DA8801935

The fluctuating electric field of plasma perturbs the atomic structure of the immersed ion or atoms. The perturbed line shape is an important diagnostic tool for the temperature and density measurements of plasma. The line shape calculation is done by first deriving the line shape expression, then it is shown that the

problem is equivalent to calculating the temperature Green's function of the bound electron. The total Hamiltonian of the system includes the atomic, plasma and atom-plasma parts. The temperature Green's function is calculated perturbatively by expanding in orders of atom-plasma interation. By solving a Dyson equation the dressed Green's function of the bound electrons are obtained. At this point the line shape is calculated by an analytic continuation from the complex frequency plane to real line. To derive the atomic electron Green's function the momentum integral in the self energy is approximated by a Riemann sum. With this approximation the algebraic form of the line shape is obtained for an undetermined number of terms in the Riemann sum. Numerical calculation of line shape is done by using this result.
Dissert. Abstr.

N88-26211# Nagoya Univ. (Japan). Inst. of Plasma Physics.
STABILITY OF SPHEROMAK AGAINST CURRENT DRIVEN MODES: EFFECTS OF FLUX HOLE ON STABILITY
Atsushi Kamitani Apr. 1988 35 p
(IPPJ-868; ISSN-0469-4732) Avail: NTIS HC A03/MF A01

The effects of the flux hole on the magnetohydrodynamic (MHD) stability of the spheromak are investigated. Since finite element codes such as ERATO and ERATO-J are not able to analyze the plasma containing the symmetry axis in itself, the numerical code by use of which the linearized MHD equation can be integrated in time was developed. By use of this code, linear growth rates of n = 1 mode are evaluated as functions of the flux-hole size and the prolateness parameter L/R, where L and R denote the height and the radius of the drum-type flux conserver, respectively. The results of computations show that the flux hole has the destabilizing effects on the spheromak and that a stable configuration with a small flux hole is obtained when the flux conserver is oblate enough to satisfy L/R approximately less than 1.8 + or - 0.1. Author

N88-26212 Science Research Council, Chilton (England).
INNER-SHELL X-RAY LINE SPECTRA OF HIGHLY IONIZED TITANIUM, CHROMIUM, IRON AND NICKEL AND THEIR APPLIATION TO LABORATORY PLASMAS
J. R. Lemen, K. J. H. Phillips, G. A. Doschek, and R. D. Cowan 1986 50 p Prepared in cooperation with Mullard Space Science Lab., Dorking, United Kingdom, Naval Research Lab., Washington, D.C. and Los Alamos National Lab., N. Mex.
(PB87-225181; RAL-86-065) Avail: NTIS HC E04/MF E04; copy not available from STI Facility CSCL 20I

The intensities of X-ray lines due to inner shell 1s-2p transitions in O 1-, N 1-, and C 1-like ions of Ti XV-XVII, Cr XVII-XIX, Fe XIX-XXI, and Ni XXI-XXIII, seen in tokamak plasmas are calculated. The lines are assumed to be formed by dielectronic recombination and inner shell excitation. The present calculations are extensions of previous work for iron alone. The dielectronic contribution for iron was found to be more important and this is true for the ions of titanium, chromium, and nickel considered here. The dielectronic rates were calculated using a suite of computer programs developed by one of us. The inner shell contribution was estimated by van Regemorter's formula. The present calculations were applied to the problem of radial ion diffusion in tokamaks. Author

N88-26213# Oak Ridge National Lab., Tenn.
A MODE-TRANSFORMING POLARIZATION-ROTATABLE LAUNCHER FOR THE ATF (ADVANCED TOROIDAL FACILITY) FUSION EXPERIMENT
T. S. Bigelow, T. L. White, H. D. Kimrey, and C. R. Schaich 1988 5 p Presented at the IEEE Antennas and Propagation International Symposium, Syracuse, N.Y., 6 Jun. 1988
(Contract DE-AC05-84OR-21400)
(DE88-005070; CONF-880658-1) Avail: NTIS HC A02/MF A01

The Advanced Toroidal Facility (ATF) fusion energy experiment at the Oak Ridge National Laboratory (ORNL) requires high-power microwaves for startup and plasma heating. Power from a gyrotron oscillator tube at 53.2 GHz will be used to ionize and heat the plasma by the electron cyclotron heating (ECH) process. The confining magnetic field of the device is either 0.95 or 1.9T. The gyrotron tube generates 200 kW in the TE sub 02 mode, which is transported in an overmoded 6.35-cm-diam circular waveguide to the ATF vacuum vessel. The launcher consists of a mode-converting Vlasov section, which converts the nonpolarized TE sub 02 wave into a linearly polarized narrow beam. The beam reflects off a tiled spherical reflector grating and is focused at the center of the plasma. The polarization can be rotated to optimize the absorption efficiency by rotating the grating in the spherical reflector. Overall system efficiency is kept high by making the twist reflector large enough to catch the Vlasov converter sidelobe power, which is partially due to mode conversion in the waveguide system. The launcher design and laboratory measurements are discussed. DOE

N88-26214# Los Alamos National Lab., N. Mex.
INERTIAL FUSION IN THE NINETIES
D. B. Harris, D. J. Dudziak, and D. C. Cartwright 1987 21 p Presented at the Fusion Power Development: Breakeven and Beyond, Princeton, N.J., 27 Aug. 1987
(Contract W-7405-eng-36)
(DE88-007913; LA-UR-88-568; CONF-870883-2) Avail: NTIS HC A03/MF A01

The 1980s has proven to be an exciting time for the inertial confinement fusion (ICF) program. Major new laser and light-ion drivers have been constructed and have produced some encouraging results. The 1990s will be a crucial time for the ICF program. A decision for proceeding with the next facility is scheduled for the early 1990s. If the decision is positive, planning and construction of this facility will occur. Depending on the time required for design and construction, this next-generation facility could become operational near the turn of the century. DOE

N88-26215# Rochester Univ., N. Y. Lab. for Laser Energetics.
ALTERNATIVE ANALYSIS OF CO2-LASER-PRODUCED PLASMA WAVES
A. Simon and R. W. Short Feb. 1988 17 p
(Contract DE-FC08-85DP-40200)
(DE88-008434; DOE/DP-40200/69) Avail: NTIS HC A03/MF A01

McIntosh has carried out experiments in which electron plasma waves produced in a gas jet target by a CO2 laser pulse were studied by picosecond-resolution Thomson scattering of a ruby laser pulse. In addition, spectra of the scattered laser light and of the fast electron were obtained. Their analysis of the data was based on the assumption that the plasma waves are created by onset of the stimulated Raman scattering instability. This led to a number of difficulties in the interpretation of the data. We show here that an alternative model of the origin of these plasma waves used previously in analyzing Raman data in several other experiments, removes all these difficulties and is in agreement with the data. In this model, the plasma waves are produced by pulses of fast electrons arising at the quarter-critical surface.
DOE

N88-26216# Michigan Univ., Ann Arbor.
PARALLEL GRADIENT EFFECTS ON ICRH (ION CYCLOTRON RESONANCE HEATING) IN TOKAMAKS Ph.D. Thesis
D. N. Smithe 1987 225 p
(Contract DE-AC05-76OR-00033)
(DE88-009038; DOE/OR-00033/T404) Avail: NTIS HC A10/MF A01

This dissertation examines the effects on Ion Cyclotron Resonance Heating of parallel nonuniformity in the magnetic field which arises from the poloidal field in a tokamak and the universal (major radius)sup -1 scaling of the cyclotron frequency. The goal of the analysis is the macroscopic warm plasma current including temperature in the sense of the finite Larmor radius expansion and the quasilocal approximation of the parallel guiding center motion. A 1-D numerical application of the fully nonlocal integral dielectric is performed. Parallel gradient effects are studied for He-3 minority, 2nd harmonic deuterium, and hydrogen minority heating in tokamaks. The results show quite significant alteration of the toroidal wavenumber absorption spectrum, and a wealth of new behavior on the local propagation scale. DOE

N88-26217# Pennsylvania State Univ., University Park. Dept. of Nuclear Engineering.
ZERO-DIMENSIONAL CALCULATION FOR ZT-H
E. H. Klevans and R. Veerasingam 27 Apr. 1988 41 p
(Contract DE-FG02-87ER-53252)
(DE88-009175; DOE/ER-53252/6) Avail: NTIS HC A03/MF A01

An improved zero-dimensional model which includes a coronal non-equilibrium treatment of impurities and which takes into account the ionization energies of deuterium and of the impurities in the energy balance for a Reversed Field Pinch (RFP) device, is applied to the study of the ZT-H device. The ZT-H device is designed to operate at 4MA and the simulations focus on 4MA operation. The studies include: (1) the effects of different (IN); (2) the effects of changing tau(sub pi), the particle lifetime of the i(sup th) impurity species; (3) the effects of having different levels of carbon inpurity; (4) the sensitivity of the model to C(sub 4RP), the multiplicative coefficient for the ramping phase which is used in the ion heating term; and (5) the effect of keeping beta(sub theta) fixed at 0.1 in tau(sub Epsilon) rather than computing beta(sub theta) from its definition. The results show that T(sub e) and T(sub i) are essentially identical and vary approximately proportionately to (IN). The effect of doubling the impurity recycling time tau(sub pi), from 5 ms to 10 ms, results in T increasing by a factor of approximately 1.6. High levels of carbon impurity are damaging to temperature behavior, e.g., increasing the carbon impurity from 5 to 10 percent of the n(sub e), requires increased ohmic heating by 20 percent in order to reach T = 3130 eV for (IN) = 6.0 x 10 to the minus 14 A-m. The model is not sensitive to small changes in the ramp coefficient C(sub 4RP). The effect of keeping beta(sub theta) constant at 0.1 is to produce higher temperatures over the cases where beta(sub theta) is not held constant. For example when (IN) = 3.0 x 10 to the minus 14 A-m and tau(sub pi) = 5.0 ms, there is an increase in T by a factor of more than two. Also with beta (sub theta) constant at 0.1, the confinement times are higher. DOE

N88-26218# Massachusetts Inst. of Tech., Cambridge. Plasma Fusion Center.
EVOLUTION OF POLOIDAL VARIATION OF IMPURITY DENSITY AND AMBIPOLAR POTENTIAL IN ROTATING TOKAMAK PLASMA, PART 2
R. Zanino Mar. 1988 31 p
(Contract DE-AC02-78ET-51013)
(DE88-009882; DOE/ET-51013/249-Pt-2; PFC/RR-88-4-Pt-2)
Avail: NTIS HC A03/MF A01

We present numerical results of a 1-D (poloidal), time dependent code for the description of ion impurity transport on a given tokamak magnetic surface, in the presence of momentum sources such that, as observed in neutral beam injection experiments, the toroidal rotation velocities be comparable to or larger than the impurity thermal speed. We show that the densities, the velocities and the ambipolar potential reach a quasi steady state characterized by significant poloidal gradients, on a time scale of the order of the collision time, i.e., faster than the radial diffusion scale. To obtain this steady state a phenomenological drag force needs be introduced; we find that a purely classical, gyroviscous force alone is apparently insufficient to obtain a steady state, within the framework of the present model which retains only the zero-th order, in the Larmor radius expansion, ion-impurity friction. DOE

N88-26219# Argonne National Lab., Ill.
MHD (MAGNETOHYDRODYNAMIC) THERMAL HYDRAULIC ANALYSIS OF THREE-DIMENSIONAL LIQUID METAL FLOWS IN FUSION BLANKET DUCTS
T. A. Hua, B. F. Picologlou, C. B. Reed, and J. S. Walker (Illinois Univ., Urbana.) Feb. 1988 22 p Presented at the International Symposium on Fusion Nuclear Technology, Tokyo, Japan, 10 Apr. 1988
(Contract W-31-109-eng-38)
(DE88-009929; CONF-880417-10; CONF-880417) Avail: NTIS HC A03/MF A01

Magnetohydrodynamic flows of liquid metals in thin conducting ducts of various geometries in the presence of strong nonuniform transverse magnetic fields are examined. The interaction parameter and Hartmann number are assumed to be large, whereas the magnetic Reynolds number is assumed to be small. Under these assumptions, viscous and inertial effects are confined in very thin boundary layers adjacent to the walls. At walls parallel to the magnetic field lines, as at the side walls of a rectangular duct, the boundary layers (side layers) carry a significant fraction of the volumetric flow rate in the form of high velocity jets. The presence of these jets strongly enhances heat transfer performance. In addition, heat transfer can be further improved by guiding the flow toward a heated wall by proper variation of wall thicknesses, duct cross sectional dimensions and/or shape. Flows in nonconducting circular ducts are also examined. Experimental results obtained from the ALEX experiments at the Argonne National Laboratory are used to validate the numerical predictions. DOE

N88-26220# Argonne National Lab., Ill.
BLANKET TECHNOLOGY EXPERIMENTS AT ARGONNE NATIONAL LABORATORY
R. F. Mattas, C. B. Reed, B. Picologlou, P. Finn, R. Clemmer, K. Porges, E. Bennett, and L. R. Turner Feb. 1988 21 p Presented at the International Symposium on Fusion Nuclear Technology, Tokyo, Japan, 10 Apr. 1988
(Contract W-31-109-eng-38)
(DE88-010006; CONF-880417-19) Avail: NTIS HC A03/MF A01

Argonne National Laboratory has the largest U.S. program for the development of blanket technology. The goals of the program are to resolve critical issues for different blanket concepts, to develop the understanding and predictive capability of blanket behavior, and to develop the technology needed to build and operate advanced fusion blankets. The projects within the program are liquid metal MHD, breeder neutronics, tritium oxidation, transient electromagnetics, FLIBE chemistry, and insulator coatings. The present status and recent results of the projects are described. DOE

N88-26221# Sandia National Labs., Albuquerque, N. Mex.
PULSED POWER DRIVER TECHNOLOGIES FOR INERTIAL CONFINEMENT FUSION POWER REACTORS
D. L. Cook 1987 19 p Presented at the 3rd ICF System and Applications Colloquium, Madison, Wis., 9 Nov. 1987
(Contract DE-AC04-76DP-00789)
(DE88-009260; SAND-88-0908C; CONF-871173-5) Avail: NTIS HC A03/MF A01

Pulsed power technology offers an efficient, low-cost, and repetitive means for generating intense light ion beams for Inertial Confinement Fusion (ICF). The technology produces a beam that couples well to matter and is scalable to very high power levels. The basic elements of pulsed power technology include capacitive energy storage, water dielectric pulse formation, vacuum inductive voltage adding, liquid metal and liquid dielectric ion sources, extraction ion diodes, plasma propagation channels, ballistic ion bunching, and gas-filled target chambers. Many of these technologies are applicable not only to production of intense light ion beams, but also may be useful for production of intense heavy ion beams and middle-weight ion beams. These emerging technologies form the basis for flexible driver systems for powering inertial confinement fusion reactors in the next century. DOE

N88-26222# California Univ., Los Angeles. School of Engineering and Applied Science.
VAPORIZATION STUDIES OF PLASMA INTERACTIVE MATERIALS IN SIMULATED PLASMA DISRUPTION EVENTS
C. A. Stone, IV, C. D. Croessmann, and J. B. Whitley Mar. 1988 47 p Prepared in cooperation with Sandia National Labs., Albuquerque, N. Mex.
(Contract DE-AC04-76DP-00789)
(DE88-010100; SAND-87-0313) Avail: NTIS HC A03/MF A01

The melting and vaporization that occur when plasma facing materials are subjected to a plasma disruption will severely limit

component lifetime and plasma performance. A series of high heat flux experiments was performed on a group of fusion reactor candidate materials to model material erosion which occurs during plasma disruption events. The Electron Beam Test System was used to simulate single disruption and multiple disruption phenomena. Samples of aluminum, nickel, copper, molybdenum, and 304 stainless steel were subjected to a variety of heat loads, ranging from 100 to 400 msec pulses of 8 to 18 kW/sq cm. It was found that the initial surface temperature of a material strongly influences the vaporization process and that multiple disruptions do not scale linearly with respect to single disruption events. DOE

N88-26223*# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.
THE EFFECTS OF MAGNETIC NOZZLE CONFIGURATIONS ON PLASMA THRUSTERS Semiannual Program Report, 5 Dec. 1987 - 4 Dec. 1988
Thomas M. York 21 Jul. 1988 6 p
(Grant NAG3-843)
(NASA-CR-183096; NAS 1.26:183096) Avail: NTIS HC A02/MF A01 CSCL 20I

Magnetoplasmadynamics (MPD) arc devices have been operated at power levels from 10 KW to 0.1 MW. When these devices have magnetic fields applied to them, they show marked increases in thrust in direct proportion to the magnitide of the applied field. Electrode erosion may be influenced by applied fields. This proposal will study the application of variable magnetic fields over a range of thruster powers, gas densities, and thruster configurations. It is proposed to examine this behavior with numerical codes and limited but relevant experimental tests. Author

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N88-26224# Lund Univ. (Sweden). Dept. of Solid State Physics.
DEFECTS IN HIGH-MOBILITY SEMICONDUCTOR SYSTEMS Interim Report No. 1
Hermann Grimmeiss 23 Oct. 1987 2 p
(Contract DAJA45-87-C-0052)
(AD-A191618) Avail: NTIS HC A02/MF A01 CSCL 20L

Initial work under subject contract was devoted to (a) assembling and calibrating essential electrical, optical, and spectroscopic measurement facilities needed for analysis of defects in high-mobility structures; (b) application of such measurement systems to study of basic defects in previously characterized materials, in order to validate techniques and also to verify and extend our understanding of the physics of such basic defects; and (c) initiation of fabrication of critical test samples comprising heterostructures and superlattices of GaAs and Si and Ge. GRA

N88-26225# Minnesota Univ., Minneapolis.
EPITAXIAL IRON FILMS Annual Report, 15 Jun. 1986 - 14 Dec. 1987
E. D. Dahlberg and P. I. Cohen 31 Jan. 1988 13 p
(Grant AF AFOSR-0201-86)
(AD-A191815; AFOSR-88-0043TR) Avail: NTIS HC A03/MF A01 CSCL 09A

The growth properties and magnetic properties of iron films grown by molecular beam epitaxy were studied. The iron film growth was first studied by growing iron on iron whiskers. This work and previous work determined the growth parameters for nearly dislocation free growth. This information was then used to grow iron films on Gallium Arsenide/Indium Arsenide alloy substrates. As determined by electron diffraction, layer by layer growth was observed when the iron films were grown. The magnetic properties of the iron films were found to be dependent up on the substrate surface morphology and lattice constant. In particular the coercivity of epitaxed iron film was found to vary by roughly a factor of four when grown on different surface morphologies and substrate lattice spacings. Other research focused on the magnetotransport and magnetooptic properties of the iron film and the effects of the substrate lattice properties on them. GRA

N88-26226# Arizona Univ., Tucson.
CENTER FOR THIN FILM STUDIES Annual Report, 1 Oct. 1986 - 1 Oct. 1987
Robert P. Shannon and Ursula J. Gibson 15 Nov. 1987 136 p
(Contract F49620-86-C-0123)
(AD-A191996; AFOSR-88-0136TR) Avail: NTIS HC A07/MF A01 CSCL 20L

This report covers the first year of operation of the URI Thin Film Center (TFC), and describes a diverse array of studies on thin-film materials, substrates, and their processing and analysis. Individual efforts are highlighted in sections on nucleation studies, ion-assisted deposition, Rutherford backscattering spectrometry, Brillouin scattering, a continuum theory of the evolution of structure in thin films, a study of polishing parameters relevant to the preparation of substrates, and the setup of a characterization facility for the Center. GRA

N88-26227# Arizona State Univ., Tempe. Coll. of Engineering and Applied Sciences.
DIGITAL CONTROL OF THE CZOCHRALSKI GROWTH OF GALLIUM ARSENIDE. SYSTEM REFERENCE MANUAL. VALID FOR CZOCHRALSKI GROWTH CONTROLLER SOFTWARE VERSION 2.4 Report, 1 Apr. - 31 Dec. 1987
Karl Riedling 4 Jan. 1988 436 p
(Contract F49620-86-C-0012; ARPA Order-9099)
(AD-A191997) Avail: NTIS HC A19/MF A01 CSCL 12G

This report provides an updated and extended description (Version 2.4) of the structure and the operation of the controller software developed for digital Czochralski Growth Control System (CGCS) for compound semiconductors. This manual outdates all previous versions. The Controller Software Reference Manual discusses the design considerations applied to digital LEC crystal growth control, gives a short overview of the growth controller computer hardware and operating system environment, describes the functions of the CGCS from an operator's point of view, and delineates the internal operations of the controller software by discussing the controller software and algorithms. Various appendices provide tables of controller software tasks, routines, and variables, file format information, and lists of system messages and error codes. GRA

N88-26228# Syracuse Univ., N. Y. Dept. of Physics.
THE CATALYTIC REACTIVITY OF THIN FILM CRYSTAL SURFACES Annual Technical Progress Report
R. W. Vook 15 Feb. 1988 16 p
(Contract DE-FG02-84ER-45139)
(DE88-006387; DOE/ER-45139/4) Avail: NTIS HC A03/MF A01

Research is being conducted on Cu/Pd and Pd/Cu thin films. Work has been completed on the following: Work Function Studies on Epitaxial Cu/Pd Bilayer Films; Kinetics of CO and Oxygen Adsorption on Smooth and Sputtered Epitaxial Pd(111) Films on Mica; A Simple Model for the Auger Electron Spectroscopy Evaluation of Thin Film Layer Growth Systems in Which Substrate-Overgrowth Mixing Occurs. Work in progress includes: AES of the Growth of Pd on (111)Cu and Cu on (111)Pd; Catalysis of the Co Oxidation Reaction on Epitaxial Cu/Pd Bilayer Films; Thermal Desorption Spectroscopy of CO from Various Thin Film Cu/Pd Bilayers; LEED Measurements; Kinetics of Adsorption of CO on Various Cu/Pd Bilayers. Author

N88-26229# Helsinki Univ. of Technology, Espoo (Finland). Electronic Circuit Design Lab.
IMPROVED DESCRIPTION OF BASE DYNAMICS IN THE MODELING OF BIPOLAR TRANSISTORS

M. Sipilae, V. Porra, and M. Valtonen Feb. 1988 35 p
(PB88-181516; ISBN-951-754-380-8; Rept-2) Avail: NTIS HC A03/MF A01 CSCL 20L

An improved nonlinear high frequency model for the bipolar transistor is presented, based on considerations of the dynamics of the charge stored in the base region. The model incorporates higher order circuit elements in order to obtain increased accuracy in circuit simulation at high frequencies. The model is derived from device physics by solving the diffusion equation in the base region by means of a quasi-static expansion. The result is a more accurate circuit representation which can be added to existing bipolar transistor models. GRA

N88-26230# California Univ., Berkeley. Lawrence Berkeley Lab.

SSC (SUPERCONDUCTING SUPER COLLIDER) MAGNET TECHNOLOGY

C. Taylor Sep. 1987 6 p Presented at the 10th International Conference on Magnet Technology (MT-10), Boston, Mass., 21 Sep. 1987
(Contract DE-AC03-76SF-00098)
(DE88-007386; LBL-23123; CONF-870901-30) Avail: NTIS HC A02/MF A01

To minimize cost of the SSC facility, small-bore high field dipole magnets have been developed; some of the new technology that has been developed at several U.S. national laboratories and in industry is summarized. Superconducting wire with high J(sub c) and filaments as small as 5 micron diameter is not produced with mechanical properties suitable for reliable cable production. A variety of collar designs of both aluminum and stainless steel have been used in model magnets. A low-heat leak post-type cryostat support system is used and a system for accurate alignment of coil-collar-yoke in the cryostat has been developed. Model magnets of 1 , 1.8 m, 4.5 m, and 17 m lengths have been build during the past two years. DOE

N88-26231# Sandia National Labs., Albuquerque, N. Mex.

X-RAY RESPONSE OF GaAlAs/GaAs RADIATION HARDENED DOUBLE: HETEROSTRUCTURE PHOTODIODE COMPARED TO Si:PIN PHOTODIODES

J. P. Anthes 1988 17 p Presented at the 7th Topical Conference on High Temperature Plasma Diagnostics, Napa, Calif., 13 Mar. 1988
(Contract DE-AC04-76DP-00789)
(DE88-007425; SAND-88-0089C; CONF-880364-7) Avail: NTIS HC A03/MF A01

Requirements for continuous operation of photodiodes in the presence of nuclear radiation has led to the development of a novel GaAlAs/GaAs photodiode. Device structure and semiconductor properties of this design were optimized to balance the need for photodetection at lambda = 820 nm against unwanted excess photocurrents induced by ionizing radiation. To achieve radiation hardness the photodiode employs a double heterojunction device structure. The spectral response of this detector, 1 keV to 10 MeV, may offer unique opportunities for use in high-temperature plasma diagnostics compared to typical bare Si:PIN X-ray photodiode characteristics. Application of this GaAlAs/GaAs detector in a fiber optic link will be reviewed. Also, use of this detector in simple atomic-absorption-edge filtered X-ray detector channels is presented. DOE

N88-26232# Oak Ridge National Lab., Tenn.

WORKSHOP REPORT AND PRESENTATIONS FROM THE SEMICONDUCTOR RESEARCH CORPORATION-DOE SEMICONDUCTOR TASK FORCE WORKSHOP

1987 210 p Workshop held at Oak Ridge, Tenn., 2 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-007690; CONF-8711158) Avail: NTIS HC A10/MF A01

The Semiconductor Research Corporation-DOE Semiconductor Task Force Workshop was held in Oak ridge, Tennessee, on November 2-3, 1987. It was to provide a forum for representatives of the national laboratories, DOE, and the semiconductor industry in which to discuss capabilities of the national laboratories which could contribute to the future competitiveness of the US semiconductor industry, to identify specific large and small projects at the national laboratories which would be of direct benefit to the semiconductor industry, and to find ways of implementing these projects. Numerous small projects were identified which would utilize unique capabilities of the national laboratories in advanced ion implantation, plasma processing (including electron cyclotron resonance plasmas), ion and cluster beam deposition, materials characterization, electronic packaging, and laser processing and deposition. Five large-scale candidate projects were identified in synchrotron x-ray lithography, silicon process integration, advanced materials processing science, process analysis and diagnostics, and ultra clean room engineering. The major obstacle to implementing these projects if the lack of appropriate funds to initiate and stimulate interactions between the national laboratories and the semiconductor industry. SEMATECH and the federal government are potential sources of seed funds for these projects. The Semiconductor Research Corporation is ideally suited to interface the semiconductor industry and the national laboratories for many of these interactions. DOE

N88-26233# International Centre for Theoretical Physics, Trieste (Italy).

SUPERCONDUCTIVE ANALOGUE OF SPIN GLASSES

M. Feigelman, L. Ioffe, V. Vinokur, and A. Larkin Jul. 1987 18 p
(DE88-702059; IC-87/173) Avail: NTIS (US Sales Only) HC A03/MF A01

The properties of granular superconductors in magnetic fields, namely the existence of a new superconductive state analogue of the low-temperature superconductive state in spin glasses are discussed in the frame of the infinite-range model and the finite-range models. Experiments for elucidation of spin-glass superconductive state in real systems are suggested. DOE

N88-26234# International Centre for Theoretical Physics, Trieste (Italy).

RCL MODEL FOR THE DEVELOPMENT OF HYSTERESIS IN SUPERCONDUCTORS

T. F. Refai and L. N. Shehata Jul. 1987 26 p
(DE88-702061; IC-87/175) Avail: NTIS (US Sales Only) HC A03/MF A01

A model is introduced to explain the development of hysteresis in superconductors in which heating effects can be ignored. The model is based on the transient phenomena that occur in RCL circuits at the instant the emf is turned off. We show that hysteresis develops when the total current (applied plus transient) exceeds the critical current I sub c (T). The model predicts several hysteretic behaviours that have been observed, and others that have not yet been experimentally observed. For the effect of temperature on the development of hysteresis we show that it is an aiding factor rather than a principle parameter. Under any operating condition the model predicts a maximum hysteresis width equal to 1/2 I sub c (T). DOE

N88-26235# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.

EFFECT OF A WEAK MAGNETIC FIELD ON HIGH TEMPERATURE SUPERCONDUCTIVITY IN Y-Ba-Cu-O CERAMICS

B. V. Vasilev and V. I. Lushchikov 1987 4 p In RUSSIAN; ENGLISH summary
(DE88-702192; JINR-R-14-87-463) Avail: NTIS (US Sales Only) HC A02/MF A01

Two effects are described which are observed in Y-Ba-Cu-O ceramic samples: a weak magnetic field affects the Volt-Amper characteristic of the superconducting state; strong absorption of electromagnetic waves takes place influenced by weak magnetic fields. The possible explanation of these effects is discussed. DOE

N88-26236 Virginia Univ., Charlottesville.
ELECTRON TUNNELING IN JUNCTIONS DOPED WITH SEMICONDUCTORS AND METALS Ph.D. Thesis
Lloyd Douglas Bell, II 1987 230 p
Avail: Univ. Microfilms Order No. DA8801172

Tunnel junctions incorporating thin layers of semiconductors and metals were analyzed. Inelastic electron tunneling spectroscopy (IETS) was employed to yield high-resolution vibrational spectra of surface species deposited at the oxide-M2 interface of M1Ox-M2 tunneling samples. Analysis was performed on the elastic component of the tunneling current, yielding information of the tunnel barrier shapes. The samples in this research exhibit a wide range of behavior. The IETS for Si, SiO2, and Ge doped samples show direct evidence of SiHx and GeHx formation. The particular species formed is shown to depend on the form of the evaporated dopant. Samples were also made with organic dopants deposited over the evaporated dopants. Thicker organic dopant layers cause large changes in the elastic tunneling barrier due to OH layer alterations or the low barrier attributes of the evaporated dopant. The trend of barrier shape with dopant thickness is examined. Many of the dopants also produce a voltage-induced shift in the barrier shape which is stable at low temperatures but relaxes at high temperature. Other dopants, such as Al, Mg, and Fe, produce different effects. These dopants cause large I-V nonlinearity at low voltages. This nonlinearity is modeled as a giant zero-bias anomaly (ZBA) and fits are presented which show good agreement with theory. For some samples, poor fits result due to additional nonlinearity at higher voltages. This is explained in terms of a barrier lowering due to disruption of the OH layer or the small bandgap of the dopant. Dissert. Abstr.

N88-26237 Virginia Univ., Charlottesville.
DIMENSIONAL CROSSOVER IN LAYERED SUPERCONDUCTORS Ph.D. Thesis
Gary Kenneth Eiserman 1987 219 p
Avail: Univ. Microfilms Order No. DA8801173

An investigation of the behavior of layered superconducting structures is presented. The temperature dependence of the upper critical field of two classes of layered materials is studied as a function of sample orientation, composition, and interlayer coupling strength. The first class of materials consists of crystals of 2H-TaS2, either in pure state or intercalated with pyridine, methylamine, ethylenediamine, or iron. The second class of materials consists of alternating thin films of niobium and silicon, niobium and germanium, or vanadium and silicon. In this second class, the thickness of the superconducting layers was held constant while the thickness of the other layers was varied from sample to sample. The experimental results are compared with the effective mass model and the theories of Klemm, Luther, and Beasley.
Dissert. Abstr.

N88-26238 Harvard Univ., Cambridge, Mass.
NOISE AND CHAOS IN DRIVEN JOSEPHSON JUNCTIONS Ph.D. Thesis
Qing Hu 1987 184 p
Avail: Univ. Microfilms Order No. DA8800792

The response of several Nb-aSi-Nb junctions to laser radiation at far-infrared frequencies, 245, 419, and 604 GHz was studied in detail. At 419 GHz, which is close to the plasma frequencies of the junctions, rich nonlinear dynamic effects exhibited in the dc I-V characteristics, such as, negative resistance regions, subharmonic steps, and noisy I-V curves were seen. By using a RSJ model, modified to include a piecewise nonlinear resistance, with an appropriate amount of noise, the dc I-V curves of the irradiated junctions can be reproduced accurately in both digital and analog simulations. The simulations showed that the response of the junctions to the laser radiation is extremely sensitive to the plasma frequency f sub p when the laser frequency f sub L is approximately f sub p. It was discovered in the simulations that the noisy I-V curves are caused by various nonlinear dynamic effects. In one of the noise-induced chaos regions, it was found that the basin boundary of attraction is fractal. The peak position of the boundary dimension vs. dc current coincides with the peak position of noise density vs. dc current in the experiment. This agreement is a strong evidence that the noise sensitivity is related to the dimension of the basin boundaries. Dissert. Abstr.

N88-26239*# National Aeronautics and Space Administration, Washington, D.C.
CARBON ANALYSIS IN NATURAL OLIVINE CRYSTALS OF DEEP ORIGIN
S. N. Shilobreyeva, A. A. Kadik, V. M. Minayev, S. S. Kazakov, and L. Ye. Kuzmin Jul. 1988 11 p Transl. into ENGLISH from Opredeleniye Ugleroda v Prirodnykh Kristallakh Olivinov Glubinnogo Proiskhozhdeniya, Doklady Akademii Nauk SSSR (USSR), v. 297, no. 2, 1987 p 457-461 Transl. by SCITRAN, Inc., Santa Barbara, Calif.
(Contract NASw-4703)
(NASA-TT-20311; NAS 1.77:20311) Avail: NTIS HC A03/MF A01 CSCL 20L

The active participation of carbon and oxidation-reduction reactions occurring in the Earth's depths could determine the oxidation- reduction status of deep rocks and magmas and consequently influence the valent state and geochemical fate of a number of transitional elements, including ore elements.
Author

N88-26240# Sandia National Labs., Albuquerque, N. Mex.
ION IMPLANTATION PROCESSING OF 3-5 STRAINED-LAYER SEMICONDUCTORS
D. R. Myers 1987 13 p
(Contract DE-AC04-76DP-00789)
(DE88-005270; SAND-87-2475C) Avail: NTIS HC A03/MF A01

Ion implantation has had a strong impact on the development of 3-5 strained-layer semiconductor (SLS) materials and device technologies. Implantation studies have helped delineate the present understanding of strained-layer stability and metastability limits. Resulting ion beam technologies have led to improvements in a variety of SLS discrete devices, including optoelectronic emitters, photodetectors, and field-effect transistors. Both SLS stability criteria and implanted SLS devices are reviewed with respect to future applications in optoelectronics. DOE

N88-26241# Brookhaven National Lab., Upton, N. Y.
EQUATION OF STATE OF SOLID NEON FROM X-RAY DIFFRACTION MEASUREMENTS TO 110 GPa
R. J. Hemley, A. P. Jephcoat, C. S. Zha, H. K. Mao, L. W. Finger, and D. E. Cox 1987 8 p Presented at the 11th International AIRAPT Conference, Kiev, (USSR), 12 Jul. 1987
(Contract DE-AC02-76CH-00016)
(DE88-008723; BNL-41069; CONF-870754-4) Avail: NTIS HC A02/MF A01

This paper briefly discusses the pressure-volume properties of condensed neon. X-ray diffraction techniques are used to determine solid neon equation of state and crystal structure. DOE

N88-26242# Lawrence Livermore National Lab., Calif.
DEVELOPMENT OF A GaAs SOLID STATE DEVICE MODEL FOR HIGH POWER APPLICATIONS
W. J. Orvis, G. H. Khanaka, and J. H. Yee Sep. 1987 8 p Presented at the 9th Annual Electrical Overstress/Electrostatic Discharge Symposium, Orlando, Fla., 29 Sep. 1987
(Contract W-7405-eng-48)
(DE88-009048; UCRL-96423; CONF-870951-1) Avail: NTIS HC A02/MF A01

Due to their speed and radiation tolerance, gallium arsenide solid state devices are becoming more and more prevalent in consumer and defense electronics. Because of this increase in use, we are modeling gallium arsenide device operation in the high power, short pulse regime. The modeling includes avalanche generation, heat generation and flow, and inter-valley transfer of electrons. This modeling is accomplished using an implicit finite difference method. DOE

N88-26243# Brookhaven National Lab., Upton, N. Y.
MAGNETIZATION STUDIES OF MULTIFILAMENTARY Nb3Sn WIRES
A. K. Ghosh and W. B. Sampson Mar. 1988 12 p
(Contract DE-AC02-76CH-00016)
(DE88-009103; BNL-41160) Avail: NTIS HC A03/MF A01

The hysteretic magnetization of Nb3Sn conductors made by several different processes were measured in transverse applied field. In most cases it was found that the effective filament size is much greater than the nominal one. Additionally niobium barriers were found to substantially increase the magnetization at all fields. The effect of varying the local niobium to copper ratio in internal tin conductors was also investigated. DOE

N88-26244# Lawrence Livermore National Lab., Calif.
SUPERFLUIDITY OF A TWO DIMENSIONAL BOSON COULOMB GAS
D. S. Peters and B. J. Alder Apr. 1988 11 p Presented at the Computer Simulation Studies in Condensed Matter Physics: Recent Developments, Athens, Ga., 23 Feb. 1988
(Contract W-7405-eng-48)
(DE88-009827; UCRL-98629; CONF-880272-1; CONF-880272)
Avail: NTIS HC A03/MF A01

Superfluidity has been observed in path integral quantum Monte Carlo calculations of a two dimensional Boson Coulomb gas to occur as in three dimensions when the deBroglie wavelength is comparable to the interparticle distance, even for this long range interaction potential. By this criterion, utilizing only the experimentally determined effective mass and charge density for the new high T(sub c) superconductors, superconducting transition temperatures in the range of 100 to 200 K are obtained, the range reflecting the experimental uncertainties in these two observables. DOE

N88-26245# Argonne National Lab., Ill.
SEARCH FOR NEW HIGH-TEMPERATURE SUPERCONDUCTING COPPER OXIDES
B. Dabrowski and D. G. Hinks Apr. 1988 6 p Presented at the Conference on Superconductivity and Applications, Buffalo, N.Y., 18 Apr. 1988
(Contract W-31-109-eng-38)
(DE88-009922; CONF-880466-2; CONF-880466) Avail: NTIS HC A02/MF A01

Resistivity measurements are a sensitive method for the detection of a superconductive phase in a multiple-phase sample. Using this technique, we have studied around 200 copper M1M2 oxide compositions with M = Th(+4), Y(+3), La(+3), Nd(+3), Bi(+3), Sr(+2), Ca(+2), Cd(+2), K(+1), or Na(+7) We did not find evidence for any new superconducting phases other then the known REBa2Cu3O7 and La 2-xM(+2)xCuO4, despite the presence of many good metallic compounds. We have found that neither the substitution of fluorine or sulfur in REBa2Cu3O7, nor temperature cycling near 240 K enhance T sub c's. However, we have found nonreproducible resistive anomalies at about 240 K which may be due to the freezing of water vapor. Also, by carefully preparing the REBa2Cu3O7 series, we find the systematic change of T sub c to be proportional to the size of RE atom. DOE

N88-26246# Northwestern Univ., Evanston, Ill. Dept. of Physics and Astronomy.
ALL-ELECTRON LOCAL DENSITY THEORY OF ELECTRONIC STRUCTURE AND SUPERCONDUCTIVITY IN YBa2Cu3O7 AND YBa2Cu3O6
A. J. Freeman, S. Massidda, Jaejun Yu, and D. D. Koelling (Argonne National Lab., Ill.) Jan. 1988 3 p Presented at the 18th Conference on Low Temperature Physics, Kyoto, Japan, 20 Aug. 1987
(Contract W-31-109-eng-38)
(DE88-009944; CONF-870873-27; CONF-870873) Avail: NTIS HC A02/MF A01

Results of highly precise all-electron local density calculations are presented for the quasi-2D superconductor YBa2Cu3O7 and for the non-superconducting YBa2Cu3O6. The two dimensionality is important for understanding various properties. As in the case of the La(sub 2-x)M(sub x)CuO4 (M = Ba, Sr,...) systems, these materials consist of metallic Cu-O planes separated by ionic (insulating) Y-O and Ba-O planes of atoms. Stoner magnetic instabilities and the role of chains vs. planes for supeconductivity are briefly discussed. DOE

N88-26247# Argonne National Lab., Ill.
STRUCTURAL AND MAGNETIC PROPERTIES OF Fe IMPURITIES IN YBa2Cu3O(SUB 7-DELTA)
B. D. Dunlap, J. D. Jorgensen, W. K. Kwok, C. W. Kimball, J. L. Matykiewicz, H. Lee, and C. U. Segre Feb. 1988 6 p Presented at the International Conference on High Temperature Superconductors and Materials and Mechanisms of Superconductivity, Interlaken, Switzerland, 29 Feb. 1988 Prepared in cooperation with Northern Illinois Univ., Dekalb and Illinois Inst. of Tech., Chicago
(Contract W-31-109-eng-38)
(DE88-009961; CONF-880206-9; CONF-880206) Avail: NTIS HC A02/MF A01

Samples having the general composition YBa2Cu(sub 1-x)Fe(sub x)3O(sub 7 -delta) have been investigated using X-ray and neutron diffraction, Moessbauer spectroscopy and bulk property measurements. X-ray and neutron data show that samples having x greater than or equal to 0.04 are tetragonal. Neutron diffraction shows that this structure is vey similar to that found for undoped YBa2Cu3O(sub 7-delta) when the oxygen concentration is low, although in the present case, the total oxygen content is found to be greater than or equal to 7 for all concentrations. Contrary to the common statement that Fe substitutes onto the Cu sites, it is found from neutron diffraction that the Cu 1 site is not occupied, and that Fe appears to have a substantial substitution for Ba. Both Moessbauer spectroscopy and heat capacity measurements show the presence of magnetic transitions at temperatures well below the superconducting transition temperature, with evidence for a large variation in magnetic transition temperatures. DOE

N88-26248# Brookhaven National Lab., Upton, N. Y.
THEORY OF OXYGEN CONTENT, ATOMIC ORDERING AND OXYGEN DIFFUSION IN 1,2,3 SUPERCONDUCTING OXIDES AS A FUNCTION OF TEMPERATURE AND OXYGEN PRESSURE
H. Bakker, J. P. A. Westerveld, D. M. R. LoCascio, and D. O. Welch 1988 4 p Presented at the Japanese Institute Metals International Symposium (JIMIS-5), Kyota, Japan, 14 Mar. 1988 Prepared in cooperation with Amsterdam Univ., Netherlands
(Contract DE-AC02-76CH-00016)
(DE88-007961; BNL-41033; CONF-880371-1) Avail: NTIS HC A02/MF A01

In a previous paper we presented a thermodynamic model that describes the oxygen content and the atomic ordering as a function of temperature and oxygen pressure. In this paper the application of the model to neutron diffraction data by Jorgensen et al. will be given and the model is applied to the problem of the oxygen diffusion. DOE

N88-25770# Bell Telephone Labs., Inc., Murray Hill, N. J.
MOLECULAR BEAM EPITAXY (MBE) FOR HIGH SPEED DEVICES
A. Y. Cho *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 16-18 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25771# Bell Telephone Labs., Inc., Murray Hill, N. J.
MULTIGIGAHERTZ LOGIC BASED ON InP-MISFET's EXHIBITING EXTREMELY HIGH TRANSCONDUCTANCE
A. Antreasyan, P. A. Garbinski, V. D. Mattera, Jr., and H. Temkin *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 19-21 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25779# Fujitsu Ltd., Atsugi (Japan).
PROGRESS AND CHALLENGES IN HEMT LSI TECHNOLOGY
Masayuki Abe, Takashi Mimura, Kazuo Kondo, and Masaaki Kobayashi *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 46-48 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25780# Rochester Univ., N. Y. Dept. of Electrical Engineering.
PICOSECOND SWITCHING IN JOSEPHSON TUNNEL JUNCTIONS
R. Sobolewski, D. R. Dykaar, T. Y. Hsiang, and G. A. Mourou *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 49-51 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25788# IBM Watson Research Center, Yorktown Heights, N.Y.
NONEQUILIBRIUM PHONONS AND DISORDER IN AI SUB x Ga SUB 1-x As
J. A. Kash, J. C. Tsang, and S. S. Jha (Tata Inst. of Fundamental Research, Bombay, India) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 76-78 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25789# Maryland Univ., College Park. Lab. for Physical Sciences.
INVESTIGATION OF PHOTOCONDUCTIVE PICOSECOND MICROSTRIPLINE SWITCHES ON SELF-IMPLANTED SILICON ON SAPPHIRE (SOS)
P. Polak-Dingels, G. Burdge, Chi H. Lee, A. C. Seabaugh, R. T. Brundage, M. I. Bell, and J. Albers (National Bureau of Standards, Gaithersburg, Md.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 79-81 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25790# Technische Univ., Aachen (West Germany). Inst. of Semiconductor Electronics.
FAST GaAs PHOTOCONDUCTIVE DETECTORS WITH HIGH SENSITIVITY INTEGRATED IN COPLANAR SYSTEMS ONTO GaAs SUBSTRATES
H. Schumacher, U. Salz, and H. Beneking *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 82-85 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25791# IBM Watson Research Center, Yorktown Heights, N.Y.
CARRIER LIFETIME VERSUS ION-IMPLANTATION DOSE IN SILICON ON SAPPHIRE
F. E. Doany, D. Grischkowsky, and C.-C. Chi *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 86-88 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25799# Hewlett-Packard Co., Palo Alto, Calif.
InP/GaInAs/InP PIN PHOTODIODE WITH FWHM LESS THAN 18 ps
S. Y. Wang, K. W. Carey, and B. H. Kolner *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 110-112 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25803# Bell Telephone Labs., Inc., Murray Hill, N. J.
DIRECT SUBPICOSECOND MEASUREMENT OF CARRIER MOBILITY OF PHOTOEXCITED ELECTRONS IN GaAs
M. C. Nuss and D. H. Auston *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 126-128 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25805# Arizona State Univ., Tempe. Center for Solid State Electronics Research.
MONTE CARLO INVESTIGATION OF HOT PHOTOEXCITED ELECTRON RELAXATION IN GaAs
M. A. Osman, M. J. Kann, D. K. Ferry, and P. Lugli (Modena Univ., Italy) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 130-132 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25807# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Computer Science.
FEMTOSECOND NONEQUILIBRIUM ELECTRONIC HEAT TRANSPORT IN THIN GOLD FILMS
S. D. Brorson, J. G. Fujimoto, and E. P. Ippen *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 136-138 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25808# IBM Watson Research Center, Yorktown Heights, N.Y.
BALLISTIC TRANSPORT AND HOT ELECTRON SPECTROSCOPY IN TUNNELING HOT ELECTRON TRANSFER AMPLIFIER (THETA)
M. Heiblum *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoeelectronics 1987 p 140-142 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25810# Texas Instruments, Inc., Dallas.
QUANTUM TRANSPORT CALCULATION OF RESONANT-TUNNELING RESPONSE TIME
William R. Frensley *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 146-148 Sponsored in part by ONR and Army Research Office (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25811# Bell Telephone Labs., Inc., Murray Hill, N. J.
RESONANT TUNNELING ELECTRON SPECTROSCOPY
F. Capasso, S. Sen (Calcutta Univ., India), A. Y. Cho, and A. L. Hutchinson *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 149-151 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25812# Ecole Polytechnique, Palaiseau (France).
HIGH-SPEED PHENOMENA IN GaAs MULTIPLE-QUANTUM-WELLS
A. Mysyrowicz, D. Hulin, A. Migus, A. Antonetti, H. M. Gibbs, N. Peyghambarian, and H. Morkoc (Illinois Univ., Urbana.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 156-158 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25813# Bell Telephone Labs., Inc., Holmdel, N. J.
PICOSECOND CARRIER TRANSPORT IN GaAs QUANTUM WELLS
Jagdeep Shah and R. A. Hopfel *In* Optical Society of America,

Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 159-161 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25814# Bell Telephone Labs., Inc., Holmdel, N. J.
QUANTUM-CONFINED STARK EFFECT IN InGaAs/InP QUANTUM WELLS GROWN BY METAL-ORGANIC CHEMICAL VAPOR DEPOSITION
I. Bar-Joseph, C. Klingshirn (Joensuu Univ., Finland), D. A. B. Miller, D. S. Chemla, U. Koren, and B. I. Miller *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 162-165 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25815# Bell Telephone Labs., Inc., Holmdel, N. J.
DYNAMICS OF BELOW-GAP PHOTOEXCITATION IN GaAs QUANTUM WELLS
J. E. Zucker, A. VonLehmen, D. S. Chemla, and J. P. Heritage (Bell Communications Research, Inc., Red Bank, N.J.) *In* Optical Society of America, Organization of a Topical Meeting on Picosecond Electronics and Optoelectronics 1987 p 166-168 (For primary document see N88-25765 19-33)
Avail: NTIS HC A10/MF A01 CSCL 09C

N88-25861# Fraunhofer-Inst. fuer Festkoerpertechnologie, Munich (West Germany).
CHARACTERISTICS OF POLYSILICON LAYERS AND THEIR APPLICATION IN SENSORS
E. Obermeier, P. Kopystynski, and R. Niessl *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 4 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 20L

N88-25862# Wisconsin Univ., Madison. Center for Applied Microelectronics.
DESIGN AND CONSTRUCTION TECHNIQUES FOR PLANAR POLYSILICON PRESSURE TRANSDUCERS WITH PIEZORESISTIVE READ-OUT Abstract Only
H. Guckel, D. W. Burns, and C. R. Rutigliano *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 2 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 20L

N88-25863# California Univ., Berkeley. Dept. of Electrical Engineering and Computer Sciences.
INTEGRATED POLYSILICON TACTILE SENSOR
A. K. Oki and R. S. Muller *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p Sponsored in part by the State of California MICRO Program (For primary document see N88-25860 19-35)
(Grant NSF ECS-81-20562)
Avail: NTIS HC A06/MF A01 CSCL 20L

N88-25872# Pennsylvania Univ., Philadelphia. Center for Sensor Technologies.
ANOMALOUS EMISSIVITY FROM PERIODIC MICRO-MACHINED SILICON SURFACES Abstract Only
Peter J. Hesketh, Benjamin Gebhart, and Jay N. Zemel *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 1 p (For primary document see N88-25860 19-35)
(Grant NSF ECS-84-12241)
Avail: NTIS HC A06/MF A01 CSCL 20L

N88-25888# Alberta Univ., Edmonton. Dept. of Electrical Engineering.
CARRIER TRANSPORT IN SEMICONDUCTOR MAGNETIC SENSORS UNDER NONUNIFORM FIELDS
H. P. Baltes, W. Allegretto, A. Nathan, and Y. Sugiyama (Electrotechnical Lab., Tokyo, Japan) *In* Novasensor, The 1986 IEEE Solid-State Sensor Workshop 1986 3 p (For primary document see N88-25860 19-35)
Avail: NTIS HC A06/MF A01 CSCL 09A

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N88-26249# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SUPERSTRINGS
A. T. Filippov 1986 21 p In RUSSIAN; ENGLISH summary (DE87-702982; JINR-R-2-86-545) Avail: NTIS (US Sales Only)HC A03/MF A01

A short review is given of attempts to unify all known elementary interactions and superstring-based approaches to their solving are briefly described. General ideas, achievements and problems of the superstring theory. The role of Faddeev-Popov ghosts and of BRST-symmetries is discussed in some detail. DOE

N88-26250# Los Alamos National Lab., N. Mex.
QUANTUM GRAVITY AND NEW FORCES
R. J. Hughes, T. Goldman, and M. M. Nieto 1988 6 p Presented at the 22nd Moriond Workshop on Neutrinos and Exotic Phenomena in Particle Physics and Astrophysics, Les Arcs, France, 23 Jan. 1988
(Contract W-7405-eng-36)
(DE88-007829; LA-UR-88-926; CONF-880173-1) Avail: NTIS HC A02/MF A01

The quantum-gravity-inspired phenomenology for gravitational forces is described. New gravitational phenomena, qualitatively similar to those attributed to the so-called fifth-force are to be expected. The parameters of a model with these features have been constrained by the geophysical tests of the inverse-square law of Stacey, et al. This model is then able to explain the apparent discrepancies between the recent results of Thieberger, Adelberger and collaborators. A striking new prediction of the model is that antiprotons should experience a substantially larger gravitational acceleration than normal matter. Gravitational red-shift experiments are also proposed as tests for the new forces. DOE

N88-26251# International Centre for Theoretical Physics, Trieste (Italy).
INITIAL VALUE PROBLEMS FOR NONLINEAR HEAT EQUATIONS
Tatsien Li and Yunmei Chen May 1987 24 p
(DE88-702021; IC-87/37) Avail: NTIS (US Sales Only) HC A03/MF A01

In this paper, we give a simple method, so called global iteration, to discuss the global existence and uniqueness of the solutions to the initial value problems of nonlinear heat equations for small initial data. In both cases the nonlinear term can depend and not depend on the unknown function itself explicitly. This method can also be used for other nonlinear evolution equations. DOE

N88-26252# International Centre for Theoretical Physics, Trieste (Italy).
GENERAL RELATIVITY INVARIANCE AND STRING FIELD THEORY
I. Ya. Arefeva and I. V. Volovich Apr. 1987 19 p
(DE88-702045; IC-87/61) Avail: NTIS (US Sales Only) HC A03/MF A01

The general covariance principle in the string field theory is considered. The algebraic properties of the string Lie derivative are discussed. The string vielbein and spin connection are introduced and an action invariant under general co-ordinate transformation is proposed. DOE

N88-26253# International Centre for Theoretical Physics, Trieste (Italy).
THERMO FIELD DYNAMICS AND PARA STATISTICAL MECHANICS

S. N. Biswas and A. Das Jul. 1987 13 p
(DE88-702057; IC-87/171) Avail: NTIS (US Sales Only) HC A03/MF A01

Within the framework of thermo field dynamics, we derive the partition functions for a harmonic oscillator obeying parafermi and parabose statistics. The thermodynamic functions are studied for different limits of the order of the statistics and are shown to have the expected behaviour. DOE

N88-26254# California Univ., Berkeley. Lawrence Berkeley Lab.
TRANSCENDING NEWTON'S LEGACY
H. P. Stapp Nov. 1987 20 p Presented at the Newton's Legacy: A Symposium on the Origins and Influence of Newtonian Science, New Orleans, La., 12 Nov. 1987
(Contract DE-AC03-76SF-00098)
(DE88-010784; LBL-24322; CONF-8711189-1; CONF-8711189)
Avail: NTIS HC A03/MF A01

Science was transformed during the twentieth century by three revolutionary developments: the special theory of relativity, the general theory of relativity, and quantum theory. These developments altered not only scientific practice, but also our ideas about the nature of science and the nature of the world itself. The author discusses these three developments with regard to both their essential differences from classical Newtonian science, and their potential impact upon the human condition. DOE

N88-26255*# Old Dominion Univ., Norfolk, Va. Dept. of Mechanical Engineering and Mechanics.
ON-LINE MEASUREMENT OF HEAT OF COMBUSTION Final Report, period ended 30 Apr. 1988
S. K. Chaturvedi and H. Chegini Jul. 1988 18 p
(Contract NAS1-17993)
(NASA-CR-183076; NAS 1.26:183076) Avail: NTIS HC A03/MF A01 CSCL 20M

An experimental method for an on-line measurement of heat of combustion of a gaseous hydrocarbon fuel mixture of unknown composition is developed. It involves combustion of a test gas with a known quantity of air to achieve a predetermined oxygen concentration level in the combustion products. This is accomplished by a feedback controller which maintains the gas volumetric flow rate at a level consistent with the desired oxygen concentration in the products. The heat of combustion is determined from a known correlation with the gas volumetric flow rate. An on-line microcomputer accesses the gas volumetric flow data, and displays the heat of combustion values at desired time intervals. Author

N88-26256# Northeastern Univ., Boston, Mass.
TOPICS IN GAUGE THEORIES AND THE UNIFICATION OF ELEMENTARY PARTICLE INTERACTIONS Progress Report, 1 Jul. 1987 - 31 Mar. 1988
Y. N. Srivastava and M. T. Vaughn Mar. 1988 8 p
(Contract DE-FG02-85ER-40233)
(DE88-008112; DOE/ER-40233/3) Avail: NTIS HC A02/MF A01

This report on work done by the principal investigators and their collaborators is on: non-scaling phenomena in very high-energy, low p(sub t) physics; probe of QED vacuum polarization via the Moessbauer effect; computer graphic representations of topological solutions to classical field equations; and p-adic string theory. DOE

N88-26257# Integral Technologies, Inc., Westmont, Ill.
MULTIDIMENSIONAL MODELING OF CONVECTIVE HEAT TRANSFER WITH APPLICATION TO I.C. ENGINES Technical Progress Report
Mark J. Jennings and Thomas Morel 23 Mar. 1988 28 p
(Contract DE-AC04-86AL-33183)
(DE88-007446; DOE/AL-33183/T6) Avail: NTIS HC A03/MF A01

The objective of this project is to develop a more comprehensive understanding of the convective heat transfer process in complex, unsteady turbulent reacting flows, typical of those which occur in internal combustion engines. Progress during the present reporting period consists of continuation of development of a wall model started during the last period. Errors identified last period were corrected and the model was tested again. Some data are presented. DOE

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N88-26258# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
ANALYSIS AND SYNTHESIS OF DECISION-MAKING ORGANIZATIONS Ph.D. Thesis
Stamatios K. Andreadakis Jan. 1988 195 p
(Contract N00014-84-K-0519)
(AD-A191948; LIDS-TH-1740) Avail: NTIS HC A09/MF A01 CSCL 05A

The objective is to design distributed decision-making organizations. The synthesis problem is formulated as follows: Given a mission, design the decision-making organization that is accurate, timely, has task throughput rate higher than the task arrival rate, and whose decisionmakers are not overloaded. The fundamental feature of the methodology is the distinction between the design of the data flow structure and the design of the organization architecture. The data flow structure synthesis focuses on information processing schemata. A classification of these structures, suitable for decision-making, is introduced, and a procedure is developed for the generation of candidate structures. The organization architecture synthesis focuses on function allocation to decisionmakers, and on the selection of the supporting systems. The candidate designs are augmented by incorporating decision support systems and communication links. The performance and effectiveness of decision-making organizations is analyzed. An information theoretic model of the human decisionmaker with bounded rationality is used to model the information processing and decision-making functions. The formalism of timed Petri Nets is employed to model the interaction of processes, and to compute time related measures of performance. The concepts of Timeliness and Survivability are investigated, and the respective measures are defined. The accuracy, response time, and maximum throughput rate, are computed. GRA

N88-26259# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
DECISION AIDING AND COORDINATION IN DECISION-MAKING ORGANIZATIONS M.S. Thesis
Jean-Louis M. Grevet Jan. 1988 166 p
(Contract N00014-84-K-0519)
(AD-A191950; LIDS-TH-1737) Avail: NTIS HC A08/MF A01 CSCL 05A

A methodology to analyze, model, and evaluate decision-making processes that require coordination is presented. The concept of a team of decision-makers and the issues of inconsistency of information and synchronization are emphasized. Predicate Transition Nets are used as the basic technique to represent organizational structures. Two measures of coordination are introduced: The degree of information consistency and the measure of synchronization. The simulation of Petri Nets is

presented as a means of investigating the dynamics of decision-making processes requiring coordination. A model of Decision Support Systems (DSS) is developed. An example of a two-person hierarchical organization aided by a DSS is given as an illustration: The accuracy, time delay and synchronization are computed. The results are that decision aids can alter the coordination of decision-making organizations by modifying the priority order with which information is processed, and by increasing the number of information flow paths with different processing times. GRA

N88-26260# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
MODELING AND EVALUATION OF EXPERT SYSTEMS IN DECISIONMAKING ORGANIZATIONS M.S. Thesis
Didier M. Perdu Dec. 1987 99 p
(Contract N00014-85-K-0782)
(AD-A191951; LIDS-TH-1726) Avail: NTIS HC A05/MF A01 CSCL 05A

The introduction of expert systems as decision aids in decisionmaking organizations will modify their performance. First, a model of symbolic computation with fuzzy logic, using Predicate Transition Nets, is presented. The basic operators AND, OR, and NOT are then used to model the most common kind of expert systems: The consultant expert system in which production rules are used for knowledge representation. This model allows to simulate the dynamical behavior of the expert system in its search for a solution and to evaluate its response time for a given input. This response time depends on the number of rules scanned by the system and on the number of interactions with the user. An Air Defense Command and Control application, involving a hierarchical organization, where the expert system is used as an aid in the fusion of inconsistent information, is then developed. A strategy involving the use of the expert system is compared to two other strategies expected to be used by a decision making facing this problem. Measures of performance (workload, timeliness, and accuracy) are evaluated for each of these strategies. The results show that the use of the expert system improves significantly the accuracy of the organization, but requires more time and increases the workload of the decision making using it. GRA

N88-26261# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
COORDINATION IN DECISION-MAKING ORGANIZATIONS
Jean-Louis M. Grevet and Alexander H. Levis Jan. 1988 28 p
(Contract N00014-84-K-0519)
(AD-A191952; LIDS-P-1738) Avail: NTIS HC A03/MF A01 CSCL 05A

A methodology to analyze, model, and evaluate decision-making processes that require coordination is presented. The issues of inconsistency of information and synchronization are emphasized. Predicate Transition Nets are used as the basic technique for representing organizational structures and for characterizing the coordination of processes. Protocols of interaction are modeled by transitions for which the rule of enablement is that the decisionmakers, when interacting, must refer to the same state of the environment. Two measures of coordination are then introduced: The degree of information consistency and the measure of synchronization. These measures are defined on the basis of the attributes of the tokens belonging to the input places of transitions modeling interactions. A recently developed simulation system for Predicate Transition Nets is used for investigating the dynamics of decisionmaking processes requiring coordination. GRA

N88-26262# National Academy of Sciences - National Research Council, Washington, D. C. Cross-Disciplinary Engineering Research Committee.
ENGINEERING RESEARCH CENTERS AND THEIR EVALUATION Final Report
Jan. 1988 17 p
(Grant NSF ENG-85-05051)
(PB88-180054) Avail: NTIS HC A03/MF A01 CSCL 05A

Recommendations regarding the National Science Foundation's (NSF) plans for evaluating existing Engineering Research Centers (ERCs) are followed up.The first six centers are evaluated. One observation is that the most prevalent types of problems found in the centers were managerial and organizational. The NSF is urged to make the third-year evaluations as constructive as possible and to avoid overmanagement of the ERCs. It is recommended that a third, probationary, option be added to the yes-no refunding decision plan, deferring the final decision for one year. Various other recommendations are made regarding the preparations for and the mechanics of the actual reviews and site visits. Certain important issues in the context of cross-disciplinary research (e.g. promotion and reward, distribution of funds) are pointed out and discussed from the standpoint of the ERC evaluation. GRA

N88-26263# Department of Energy, Washington, D. C. Office of Program Analysis
PROCEDURES FOR PEER REVIEW ASSESSMENTS
1988 31 p
(DE88-007749; DOE/ER-0357) Avail: NTIS HC A03/MF A01

The Office of Program Analysis (OPA) conducts peer reviews of DOE research and development programs. The reviews are performed by examining individual projects which comprise the programs and assess the quality of the research, quality of the research team, productivity, and mission relevance for each project reviewed. DOE

N88-26264*# Management Learning Systems, Silver Spring, Md.
ANATOMY OF AN ORGANIZATIONAL CHANGE EFFORT AT THE LEWIS RESEARCH CENTER Final Report
James R. Hawker and Richard S. Dali Washington NASA Apr. 1988 34 p
(Contract C21660-K)
(NASA-CR-4146; E-4127; NAS 1.26:4146) Avail: NTIS HC A03/MF A01 CSCL 05A

By 1979, after a long decline following the end of the Apollo program, the Lewis Research Center found its very existence endangered because it was not doing the kind of research that could attract funding at the time. New management under Andrew J. Stofan applied a program of strategic planning, participative management, and consensus decision making. A corporate-cultural change was effected which enabled Lewis to commit itself to four fundable research and development projects. Morale-building and training programs which were essential to this change are described. J.P.B.

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N88-26265# Naval Ocean Systems Center, San Diego, Calif.
REAL TIME DATA BASE MANAGEMENT Professional Paper, period ending Jun. 1986
Dana L. Small Oct. 1987 7 p
(AD-A191758) Avail: NTIS HC A02/MF A01 CSCL 12G

Navy C3 systems have at their core a requirement for a significant software methodology for managing a massive Command, Control, Communications, and Intelligence (C3I) system encompassing land, sea, and airborne elements. Driving such systems are significant real-time requirements for tracking thousands of objects, discriminating the real threats among them, and tracking them by using an intelligent analysis of which objects are decoys and which are threats. The analysis is necessarily

distributed and requires substantial data that must be consistent, always available, and accessible. GRA

N88-26059# Institut Francais de Recherche pour l'Exploitation de la Mer, Brest (France).
THE CERSAT ARCHIVING AND PROCESSING CENTER [LE CENTRE ERS POUR L'ARCHIVAGE ET LE TRAITEMENT (CERSAT)]
Patrick Farcy and A. Cavanie *In* ESA, Proceedings of the Colloquium on Space and Sea Mar. 1988 p 311-316 In FRENCH (For primary document see N88-26016 19-51)
Copyright Avail: NTIS HC A15/MF A01

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N88-26266# Oak Ridge National Lab., Tenn.
A COMPARATIVE STUDY OF PROJECT ESTIMATING TOOLS
K. A. Jones, A. R. Sadlowe, M. L. Emrich, L. F. Arrowood, B. D. Watson, and R. Surapaneni 1987 25 p Presented at the NARDAC Washington/ORNL/DSRD Conference on Expert Systems Technology in the ADP Environment, Washington, D.C., 2 Nov. 1987
(Contract DE-AC05-84OR-21400)
(DE88-009059; CONF-871128-2) Avail: NTIS HC A03/MF A01

Existing project estimation software may adequately estimate programming costs associated with large software development projects. However, customizing these packages to reflect unique organizational requirements may be difficult. In addition, such systems may not offer justifications for indicated costs and personnel levels. A knowledge-based system, ADP-Estimator, is being developed to estimate project resources and costs. Such knowledge-based software can retain estimating expertise and make it available to other personnel. DOE

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N88-26267# Institute for Defense Analyses, Alexandria, Va.
REALISTIC PLANNING SCENARIOS Final Report
Barry M. Blechman, Marc E. Smyrl, and Victor A. Utgoff Jul. 1987 541 p
(Contract MDA903-84-C-0031)
(AD-A191640; AD-E500957; IDA-P-2030; IDA/HQ-87-32481)
Avail: NTIS HC A23/MF A01 CSCL 05D

The study examines the changes in international relations and in the behavior of the great powers that would be required to move the U.S. and the U.S.S.R. from their present stance of competition short of war to one of direct military conflict. While the study of course does not attempt to predict the future, it does isolate those key variables that will determine the evolution of the international environment and suggest internally consistent patterns into which these variables might develop. In this way, a number of plausible alternative futures leading to U.S./Soviet war are constructed. These alternative futures can be used to test whether the U.S. defense posture is adequately robust to deal with the wide variety of potential challenges it may be asked to deter or defend against in the future. GRA

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N88-26268# Sandia National Labs., Albuquerque, N. Mex.
TECHNOLOGY TRANSFER, SANDIA NATIONAL LABORATORIES Annual Report, fiscal year 1987
Apr. 1988 33 p
(Contract DE-AC04-76DP-00789)
(DE88-009790; SAND-87-0749) Avail: NTIS HC A03/MF A01

Sandia National Laboratories, a national security engineering and science laboratory, strives to make its new technology easily accessible to U.S. private industry, local and state governments, universities, and other Federal laboratories. This goal of extending technological advancements beyond our national defense priorities is consistent with the wider concept that our security is strengthened by energy stability, economic competitiveness, environmental preservation, and other areas that maintain our national vitality. In addition, the Technology Transfer Program selectively targets recipients of information and enhances information control aspects of national security. This report reflects examples of technology transfer from the past year and summarizes some of our activities and concerns. DOE

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N88-26269# Washington Univ., Seattle. Dept. of Astronomy.
SW UMa AND V426 Oph: EXOSAT SURPRISES
Paula Szkody [1988] 5 p
Avail: NTIS HC A02/MF A01

EXOSAT results on the dwarf nova SW UMa and the nova-like V426 Oph earmark these objects as unusual cataclysmic variables (CV). SW UMa is a strong soft (0.07 to 0.21 keV) source for its faint optical magnitude (V = 16.5), but shows no evidence for a harder (greater than 10 keV) component. The soft component is modulated at the orbital period (82 min) with the peak emission at phase 0.3, coincident with optical and spectroscopic modulations. V426 Oph is a strong medium energy source (30 keV) and shows a modulation at a one hour timescale during its 6 hour orbit, implying a possible DQ Her type system. Author

N88-26270 Kansas Univ., Lawrence.
DOPPLER DISTORTION OF SOLAR FRAUNHOFER LINES IN ZODIACAL LIGHT BY REFLECTION FROM INTERPLANETARY DUST Ph.D. Thesis
Dean Carlyle Hirschi 1987 183 p
Avail: Univ. Microfilms Order No. DA8727607

The effects that distributions of orbital eccentricity, radial outflowings of particles, and radiative pressure have on both the shift and distortion of the scattered Fraunhofer line are studied. The location of the various features depends on the exact parameters used to obtain the distorted line profile. Radiation pressure and orbital eccentricity add more complexity as both could broaden the scattered line profile and shift it to red in the

evening sky. At a 180 degree elongation angle, a distortion of orbital eccentricity widens the line, whereas particles in circular orbit, even with radiation pressure, do not. The line profile shows the minimum width when all orbits are circular. When all the particles are in nearly parabolic orbits, the line profile can be broadened to the maximum width. An outward moving component of the dust is found to give a non-zero shift opposite the Sun. Since radiation pressure does not affect the light scattered from circular orbits in the area opposite the Sun, and since an outflowing of particles would be most evident in the spectra taken opposite the Sun, this area of the sky would be the most suited in separating out the effects of orbital eccentricity, radiation pressure, and radial outflow. Dissert. Abstr.

N88-26271*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
INVESTIGATION OF THE DIFFUSE ULTRAVIOLET BACKGROUND WITH DE DATA Final Technical Report, 15 Jul. 1986 - 14 Jan. 1988
John D. Fix 22 Jul. 1988 19 p
(Grant NAG5-805)
(NASA-CR-182863; NAS 1.26:182863) Avail: NTIS HC A03/MF A01 CSCL 03A

The imaging instrumentation on the Dynamics Explorer 1 satellite is used to measure the intensity of the diffused ultraviolet radiation on two great circles about the sky. It was found that the extragalactic component of the diffuse ultraviolet radiation has an intensity of 530 + or - 15 units (a unit is one photon/(sq cm s A sr) at a wavelength of 150 nm. The galactic component of the diffuse ultraviolet radiation has a dependence on galactic latitude which requires strongly forward scattering particles if it is produced by dust above the galactic plane. Author

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.
For related information see also *75 Plasma Physics*.

N88-26272# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
N=2 SUPERGRAVITY IN SUPERSPACE: SOLUTION TO THE CONSTRAINTS
A. S. Galperin, Nguyen Anh Ky, and E. Sokachev 1987 20 p
(DE88-702135; JINR-E-2-87-84) Avail: NTIS (US Sales Only) HC A03/MF A01

This is the first of a series of papers in which we develop the off-shell unconstraint formulation of N=2 supergravity in harmonic superspace. Here we construct the elements of differential geometry in terms of the prepotentials (the analytic vielbeins of the harmonic covariant derivative D sup ++). Thus, we find the solution to the constraints of the first off-shell version of Einstein N=2 supergravity. A number of useful building blocks with simple transformation laws are constructed from the prepotentials. They are used to write down a density for the full supervolume of harmonic superspace. DOE

N88-26273# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
N=2 SUPERGRAVITY IN SUPERSPACE: THE INVARIANT ACTION
A. S. Galperin and E. Sokachev 1987 12 p
(DE88-702136; JINR-E-2-87-85) Avail: NTIS (US Sales Only) HC A03/MF A01

This paper continues the formulation of harmonic superspace supergravity. We write down the invariant action for the first off-shell version of the theory. The proof of the invariance relies on the existence of a new hybrid basis in harmonic superspace in which semi-chirality combined with analyticity are manifest. DOE

N88-26274# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
N=2 SUPERGRAVITY IN SUPERSPACE: DIFFERENT VERSIONS AND MATTER COUPLINGS
A. S. Galperin, E. A. Ivanov, V. I. Ogievetskij, and E. Sokachev 1987 18 p
(DE88-702137; JINR-E-2-87-86) Avail: NTIS (US Sales Only) HC A03/MF A01

This paper concludes the formulation of N=2 supergravity in harmonic superspace. We generalize the approach developed earlier to include conformal supergravity. The superconformal group is then compensated by coupling to a Maxwell and various matter multiplets. All the previously known versions of N=2 Einstein supergravity are reproducible in this way. We give explicitly one example (with the nonlinear multiplet as a compensator). Our main result is a new version of N=2 Einstein supergravity which involves an off-shell complex hypermultiplet with its infinitely many auxiliary fields. We believe this version to be most fundamental. It is the only one in which the analytic supervolume can be made invariant. This property allows us to write down the most general matter couplings. In contrast, the absence of a proper analytic density in the other versions imposes severe restrictions on matter couplings. DOE

N88-26275# Tokyo Univ. (Japan). Inst. of Space and Astronautical Science.
COMETARY NUCLEUS AS AGGREGATE OF PLANETESIMALS
Tetsuo Yamamoto and Takashi Kozasa Jun. 1987 35 p
(ISAS-RN-364) Avail: NTIS HC A03/MF A01

Properties of planetesimals and their aggregates that formed in the primordial solar nebula and would have survived up to the present time are studied in relation to the origin of comets. The result that a planetesimal of small mass is formed by nonhomologous sedimentation of grains is taken into account in determining the initial mass of a planetesimal. Analytic formulas are presented for the mass of the aggregates, their size, and the number of planetesimals that compose the aggregate; each is expressed as a function of the heliocentric distance. It is pointed out that the mass of a planetesimal formed by gravitational instability of the dust layer is related to the total number of comets. From a comparison of the total number of comets and aggregates of planetesimals, it is shown that the initial mass of a planetesimal is .0001 to .000001 time smaller that that estimated by assuming complete sedimentation of grains. Spatial distribution and mass spectrum of the aggregates are calculated. The spatial distribution shows that most of the aggregates are populated outside the planetary region, and has a maximum around a few hundred Au. It is shown that, if the surface density of grains in the solar nebula is expressed by a power law of the heliocentric distance, the differential mass spectrum is approximated by a power law with the exponent of -5/3 for a wide range of mass, regardless of the power index of the grain surface density. Author

N88-26276 Helsinki Univ. of Technology, Kylmaelae (Finland). Metsahovi Radio Research Station.
SOLAR MICROWAVE RADIATION MAPS MEASURED AT METSAEHOVI RADIO RESEARCH STATION IN 1980-1981
S. Urpo, S. Pohjolainen, and H. Teraesranta [1988] 112 p
(PB88-193453; ISBN-951-754-416-2; SER-A-2) Copyright Avail: Issuing Activity CSCL 03B

The Radio Laboratory of the Helsinki University of Technology operates at the Metsahovi Radio Research Station. The telescope was used for solar research irregularly since 1976. Solar mapping with mini-computer based recordings started in 1978. Measurements include maps of the whole or part of the Sun, tracking of active regions and solar oscillation monitoring. The purpose is to publish at least one map for each of the days when measurements were performed. GRA

N88-26277# Lawrence Livermore National Lab., Calif.
HEAVY ION COLLISIONS WITH A = 10(SUP 57): ASPECTS OF NUCLEAR STABILITY AND THE NUCLEAR EQUATION OF STATE IN COALESCING NEUTRON-STAR BINARY SYSTEMS

G. J. Mathews, J. R. Wilson, C. R. Evans, and S. L. Detweiler (Florida Univ., Gainesville.) Dec. 1987 8 p Presented at the Symposium on Hot Nuclei, College Station, Tex., 7 Dec. 1987
(Contract W-7405-eng-48)
(DE88-008029; UCRL-97950; CONF-871243-9) Avail: NTIS HC A02/MF A01

The dynamics of the final stages of the coalescence of two neturon stars (such as the binary pulsar PSR 1913+16) is an unsolved problem in astrophysics. Such systems are probably efficient generators of gravitational radiation, and may be significant contributors to heavy-element nucleosynthesis. The input physics for the study of such systems is similar to that required for the study of heavy-ion collision hydrodynamics; e.g., a finite temperature nuclear equation of state, properties of nuclei away from stability, etc. We discuss the development of a relativistic hydrodynamics code in three spatial dimensions for the purpose of studying such neutron-star systems. The properties of the mass-radius relation (determined by the nuclear equation of state) may lead to a proposed mechanism by which hot, highly neutronized matter is ejected from the coalescing stars. This material is photodisintegrated into a free (mostly) neutron gas which may subsequently experience rapid-neutron capture (r-process) nucleosynthesis. DOE

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.
For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N88-26278 Heidelberg Univ. (West Germany).
VOYAGER IMAGING PHOTOMETRY AND RADIATIVE TRANSFER MODELING OF THE SPOKE-LIKE FEATURES IN SATURN'S OUTER B-RING Ph.D. Thesis
Laurance Reeve Doyle [1987] 175 p
Avail: Univ. Microfilms Order No. DA8729921

The spoke-like radial features in Saturn's outer B-ring were photometrically examined to constrain their nature and size thereby testing various theories as to their origin and evolution. Voyager 1 and 2 imaging data of the outer B-ring and spokes were photometrically corrected with four sets of photometric data being collected. These data sets are from bright and dark B-ring and spoke averaged line scans taken in fourteen different images each at different phase angles from 6 to 154 deg. These data sets are modeled with multiple scattering radiative transfer equations varying the parameters of large and small particle albedo, large and small particle phase function, and fraction of small particles. The results indicate a 4 percent average optical depth for the spokes, with the source for the spokes being indicated as the dark B-rings. Two additional color data sets, one in backscatter and one in forwardscatter geometry, were also collected. The images from each data set were taken at essentially identical geometries, so that direct color analysis of the B-rings and spokes could be done. Dissert. Abstr.

N88-26279*# National Aeronautics and Space Administration, Washington, D.C.
PLANETARY GEOLOGY: GOALS, FUTURE DIRECTIONS, AND RECOMMENDATIONS Final Report
Aug. 1988 23 p Workshop held in Tempe, Ariz., Jan. 1987
(NASA-CP-3005; NAS 1.55:3005) Avail: NTIS HC A03/MF A01 CSCL 03B

Planetary exploration has provided a torrent of discoveries and a recognition that planets are not inert objects. This expanded view has led to the notion of comparative planetology, in which the differences and similarities among planetary objects are assessed. Solar system exploration is undergoing a change from an era of reconnaissance to one of intensive exploration and focused study. Analyses of planetary surfaces are playing a key role in this transition, especially as attention is focused on such exploration goals as returned samples from Mars. To assess how the science of planetary geology can best contribute to the goals of solar system exploration, a workshop was held at Arizona State University in January 1987. The participants discussed previous accomplishments of the planetary geology program, assessed the current studies in planetary geology, and considered the requirements to meet near-term and long-term exploration goals. Author

N88-26280*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric, and Planetary Sciences.
KINETICS OF THERMOCHEMICAL GAS-SOLID REACTIONS IMPORTANT IN THE VENUS SULFUR CYCLE Final Report, 1 Nov. 1985 - 31 Oct. 1988
Bruce Fegley, Jr. Jul. 1988 24 p
(Grant NAGw-821)
(NASA-CR-182963; NAS 1.26:182963) Avail: NTIS HC A03/MF A01 CSCL 03B

The thermochemical net reaction $CaCO_3 + SO_2$ yields $CaSO_4 + CO$ is predicted to be an important sink for incorporation of SO_2 into the Venus crust. The reaction rate law was established to understand the dependence of rate on experimental variables such as temperature and partial pressure of SO_2, CO_2, and O_2. The experimental approach was a variant of the thermogravimetric method often employed to study the kinetics of thermochemical gas-solid reactions. Clear calcite crystals were heated at constant temperature in SO_2-bearing gas streams for varying time periods. Reaction rate was determined by three independent methods. A weighted linear least squares fit to all rate data yielded a rate equation. Based on the Venera 13, 14 and Vega 2 observations of CaO content of the Venus atmosphere, SO_2 at the calculated rate would be removed from the Venus atmosphere in about 1,900,00 years. The most plausible endogenic source of the sulfur needed to replenish atmospheric SO_2 is volcanism. The annual amount of erupted material needed for the replenishment depends on sulfur content; three ratios are used to calculate rates ranging from 0.4 to 11 cu km/year. This geochemically derived volcanism rate can be used to test if geophysically derived rates are correct. The work also suggests that Venus is less volcanically active than the Earth. J.P.B.

N88-26281*# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth, Atmospheric, and Planetary Sciences.
THE RATE OF VOLCANISM ON VENUS
Bruce Fegley, Jr. and Ronald G. Prinn 12 Jul. 1988 12 p
Submitted for publication
(Grant NAGw-321)
(NASA-CR-183039; NAS 1.26:183039) Avail: NTIS HC A03/MF A01 CSCL 03B

The maintenance of the global H_2SO_4 clouds on Venus requires volcanism to replenish the atmospheric SO_2 which is continually being removed from the atmosphere by reaction with calcium minerals on the surface of Venus. The first laboratory measurements of the rate of one such reaction, between SO_2 and calcite ($CaCO_3$) to form anhydrite ($CaSO_4$), are reported. If the rate of this reaction is representative of the SO_2 reaction rate at the Venus surface, then we estimate that all SO_2 in the Venus atmosphere (and thus the H_2SO_4 clouds) will be removed in 1.9 million years unless the lost SO_2 is replenished by volcanism. The required rate of volcanism ranges from about 0.4 to about 11 cu km of magma erupted per year, depending on the assumed sulfur content of the erupted material. If this material has the same composition as the Venus surface at the Venera 13, 14 and Vega 2 landing sites, then the required rate of volcanism is about 1 cu km per year. This independent geochemically estimated rate can be used to determine if either (or neither) of the two discordant (2 cu km/year vs. 200 to 300 cu km/year) geophysically estimated rates is correct. The geochemically estimated rate also suggests that Venus is less volcanically active than the Earth. Author

N88-26282*# Arizona State Univ., Tempe. Dept. of Geology.
THE VIKING LANDING SITES: A CARTOGRAPHIC PERSPECTIVE

Stephen Paul Meszaros May 1988 37 p
(Grant NsG-2284)
(NASA-CR-177486; NAS 1.26:177486) Avail: NTIS HC A03/MF A01 CSCL 03B

Presented is a brief guide to the maps of Mars which contain the Viking 1 and Viking 2 landing sites. Included are maps and photomosaics originally produced at the following scales: 1:25 million, 1:15 million, 1:5 million, 1:2 million, 1:1 million, and 1:250,000. In each case the Viking locations are indicated on the maps and photomosaics. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N88-26283 Kansas Univ., Lawrence.
GONE WITH THE SOLAR WIND: A STUDY OF PROTONS ACCELERATED BY INTERPLANETARY SHOCKS Ph.D. Thesis
Ramona Louise Kessel [1987] 282 p
Avail: Univ. Microfilms Order No. DA8727618

The availability of high time resolution spacecraft data has made possible in-situ and detailed study of plasma processes in the interplanetary medium. One important process that has received a lot of attention is the energization of charged particles due to the interaction with traveling interplanetary shock waves. The specific goal is to make use of observed magnetic fields, plasma density and velocity, and initial particle trajectories calculated from real spacecraft orientations in a time-reversed computer simulation which follows particles through a single complete interaction with a shock in order to predict the angular distribution of energetic protons. The shock is considered to be a planar surface. Shock parameters used in the simulation are determined from plasma and magnetic field observations fit to the Rankine-Hugoniot equations which conserve mass, momentum, and energy across the shock surface. Shock normals are determined from the single spacecraft method of Lepping and Argentiero (1971) and from the method of Vinas and Scudder (1986) using the Imp 8 magnetic field data and OMNI plasma data. Energy gains and losses are used to predict the amount of enhancement in each sector, assuming an isotropic ambient medium and a relationship between energy and particle number that is based on a power law.
Dissert. Abstr.

N88-26284# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 521, JANUARY 1988. PART 1: (PROMPT REPORTS). DATA FOR DECEMBER 1987, NOVEMBER 1987 AND LATE DATA
Helen E. Coffey and John A. McKinnon Jan. 1988 108 p
(Contract N00014-86-F-0049)
(PB88-179213; SGD-521-Pt-1; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A06/MF A01 CSCL 03B

Included are the: detailed index for 1987; data for December 1987 (advance and worldwide IUWDS alert periods, solar activity indices, solar flares, solar radio emission, Stanford mean solar magnetic field); data for November 1987 (solar active regions, sudden ionospheric distrubances, solar radio spectral observations, cosmic ray measurement by neutron monitor, geomagnetic indices, radio propagation indices); and late data (cosmic ray neutron monitor, solar radio spectral observations). GRA

N88-26285# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 521, JANUARY 1988. PART 2: (COMPREHENSIVE REPORTS). DATA FOR JULY 1987 AND MISCELLANEA
Helen E. Coffey and John A. McKinnon Jan. 1988 53 p
(Contract N00014-86-F-0049)
(PB88-179221; SGD-521-Pt-2; ISSN-0038-0911; LC-79-640375)
Avail: NTIS HC A04/MF A01 CSCL 03B

Included are the: detailed index for 1987; data for July 1987 (Meudon Carte Synotpique, solar flares, solar radio bursts are fixed frequencies, solar X-ray radiation for GOES satellite, mass ejections from the sun, active prominences and filaments); and miscellaneous data (solar X-ray flare events May-December 1984). GRA

N88-26286# Los Alamos National Lab., N. Mex.
THE SOLAR FLARE OF 18 AUGUST 1979: INCOHERENT SCATTER RADAR DATA AND PHOTOCHEMICAL MODEL COMPARISONS
J. Zinn, C. D. Sutherland, E. E. Fenimore, and S. Ganguly Apr. 1988 26 p
(Contract W-7405-eng-36)
(DE88-007616; LA-11200-MS) Avail: NTIS HC A03/MF A01

Measurements of electron density at seven D-region altitudes were made with the Arecibo radar during a Class-X solar flare on 18 August 1979. Measurements of solar X-ray fluxes during the same period were available from the GOES-2 satellite (0.5 to 4 angstrom and 1 to 8 angstrom) and from ISEE-3 (in four bands between 26 and 400 keV). From the X-ray flux data we computed ionization rates in the D-region and the associated chemical changes, using a coupled atmospheric chemistry and diffusion model (with 836 chemical reactions and 19 vertical levels). The computed electron densities matched the data fairly well after we had adjusted the rate coefficients of two reactions. We discuss the hierarchies among the many flare-induced chemical reactions in two altitude ranges within the D-region and the effects of adjusting several other rate coefficients. DOE

N88-26287*# Stanford Univ., Calif. Center for Space Science and Astrophysics.
THE RATIO OF MICROWAVES TO X-RAYS IN SOLAR FLARES: THE CASE FOR THE THICK TARGET MODEL
Edward T. Lu and Vahe Petrosian Jun. 1988 25 p
(Grants NsG-7092; NSF ATM-87-05084)
(NASA-CR-183102; NAS 1.26:183102; CSSA-ASTRO-88-08)
Avail: NTIS HC A03/MF A01 CSCL 03B

The expected ratio of synchrotron microwave radiation to bremsstrahlung X-rays for thick target, thin target, and multithermal solar flare models is calculated. The calculations take into account the variation of the microwave to X-ray ratio with X-ray spectral index. The theoretical results are compared with observed ratios of a sample of 51 solar flares with well known spectral index. From this it is concluded that the nonthermal thick target model with a loop length of and order of 10 to the 9th power cm and a magnetic field of 500 + or - 200 G provides the best fit to the data. The thin target and multithermal models require unreasonably large density or pressure and/or low magnetic field to match the data. Author

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

N88-26288# Los Alamos National Lab., N. Mex.
PRODUCTS FROM COSMIC-RAY INTERACTIONS IN EXTRATERRESTRIAL MATTER: WHAT THEY TELL US ABOUT RADIATION BACKGROUNDS IN SPACE
R. C. Reedy 1987 7 p Presented at the Conference on High Energy Radiation Backgrounds in Space, Sanibel Island, Fla., 3 Nov. 1987
(Contract W-7405-eng-36)
(DE88-009143; LA-UR-88-1176; CONF-8711149-3) Avail: NTIS HC A02/MF A01

The nuclides and the heavy-nuclei tracks made by the interactions of solar and galactic cosmic-ray particles with meteorites, lunar samples, and the Earth have been extensively studied, simulated, and modelled. Most research involves the use of these cosmogenic products to study the history of the targets

or of the cosmic rays. However, much work has also been done in understanding these interactions and in predicting their rates as a function of the target's size and shape and of the location inside the target. These studies apply to any object exposed to cosmic rays. The fluxes as a function of depth for cosmic-ray primary and secondary particles vary greatly with particle energy and type. The variations of the fluxes of these cosmic rays in the past have been studied. Energetic solar particles are unpredictable and are the greatest potential radiation hazard in space. DOE

99 GENERAL

No abstracts in this category.

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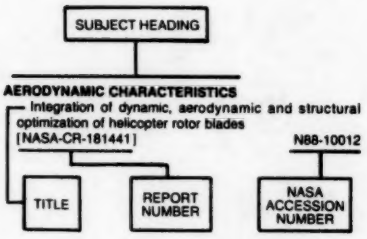

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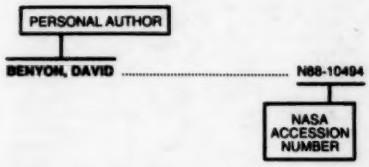

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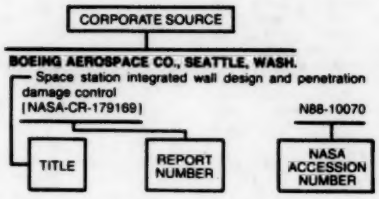

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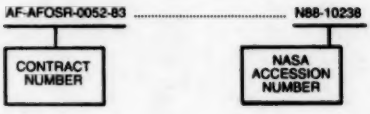

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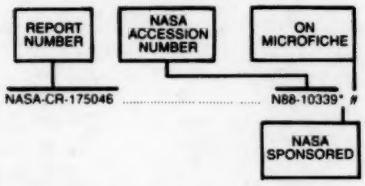

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DETROIT PUBLIC LIBRARY
Sociology Department
5201 Woodward Avenue
Detroit, MI 48202-4093
(313) 833-1409

MICHIGAN STATE LIBRARY
P.O. Box 30007
Lansing, MI 48909
(517) 373-1593

MINNESOTA

UNIVERSITY OF MINNESOTA
Government Pubs. Division
409 Wilson Library
309 19th Avenue South
Minneapolis, MN 55455
(612) 373-7870

MISSISSIPPI

UNIV. OF MISSISSIPPI LIB.
Documents Department
University, MS 38677
(601) 232-5857

MONTANA

UNIV. OF MONTANA
Mansfield Library
Documents Division
Missoula, MT 59812
(406) 243-6700

NEBRASKA

UNIVERSITY OF NEBRASKA - LINCOLN
Love Library
Documents Department
Lincoln, NE 68588-0410
(402) 472-2562

NEVADA

UNIVERSITY OF NEVADA LIB.
Govt. Pub. Department
Reno, NV 89557-0044
(702) 784-6579

NEW JERSEY

NEWARK PUBLIC LIBRARY
5 Washington Street
Newark, NJ 07101-0630
(201) 733-7812

NEW MEXICO

UNIVERSITY OF NEW MEXICO
Zimmerman Library
Government Pub. Dept.
Albuquerque, NM 87131
(505) 277-5441

NEW MEXICO STATE LIBRARY
Reference Department
325 Don Gaspar Avenue
Santa Fe, NM 87503
(505) 827-3826

NEW YORK

NEW YORK STATE LIBRARY
Empire State Plaza
Albany, NY 12230
(518) 474-5563

NORTH CAROLINA

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Davis Library
BA/SS Documents Division
Chapel Hill, NC 27515
(919) 962-1151

NORTH DAKOTA

UNIVERSITY OF NORTH DAKOTA
Chester Fritz Library
Documents Department
Grand Forks, ND 58202
(701) 777-4629
In cooperation with North Dakota State Univ. Library

OHIO

STATE LIBRARY OF OHIO
Documents Department
65 South Front Street
Columbus, OH 43266-0334
(614) 462-7051

OKLAHOMA

OKLAHOMA DEPT. OF LIB.
Government Documents
200 NE 18th Street
Oklahoma City, OK 73105
(405) 521-2502, ext. 252

OKLAHOMA STATE UNIV. LIB.
Documents Department
Stillwater, OK 74078
(405) 624-6546

OREGON

PORTLAND STATE UNIV. LIB.
Documents Department
P.O. Box 1151
Portland, OR 97207
(503) 229-3673

PENNSYLVANIA

STATE LIBRARY OF PENN.
Government Pub. Section
P.O. Box 1601
Harrisburg, PA 17105
(717) 787-3752

TEXAS

TEXAS STATE LIBRARY
Public Services Department
P.O. Box 12927—Cap. Sta.
Austin, TX 78711
(512) 475-2996

TEXAS TECH. UNIV. LIBRARY
Govt. Documents Department
Lubbock, TX 79409
(806) 742-2268

UTAH

UTAH STATE UNIVERSITY
Merrill Library, U.M.C. 30
Logan, UT 84322
(801) 750-2682

VIRGINIA

UNIVERSITY OF VIRGINIA
Alderman Lib.—Public Doc.
Charlottesville, VA 22903-2498
(804) 924-3133

WASHINGTON

WASHINGTON STATE LIBRARY
Documents Section
Olympia, WA 98504
(206) 753-4027

WEST VIRGINIA

WEST VIRGINIA UNIV. LIB.
Documents Department
Morgantown, WV 26506-6069
(304) 293-3640

WISCONSIN

MILWAUKEE PUBLIC LIBRARY
814 West Wisconsin Avenue
Milwaukee, WI 53233
(414) 278-3065

ST. HIST LIB. OF WISCONSIN
Government Pub. Section
816 State Street
Madison, WI 53706
(608) 262-4347

WYOMING

WYOMING STATE LIBRARY
Supreme Ct. & Library Bld.
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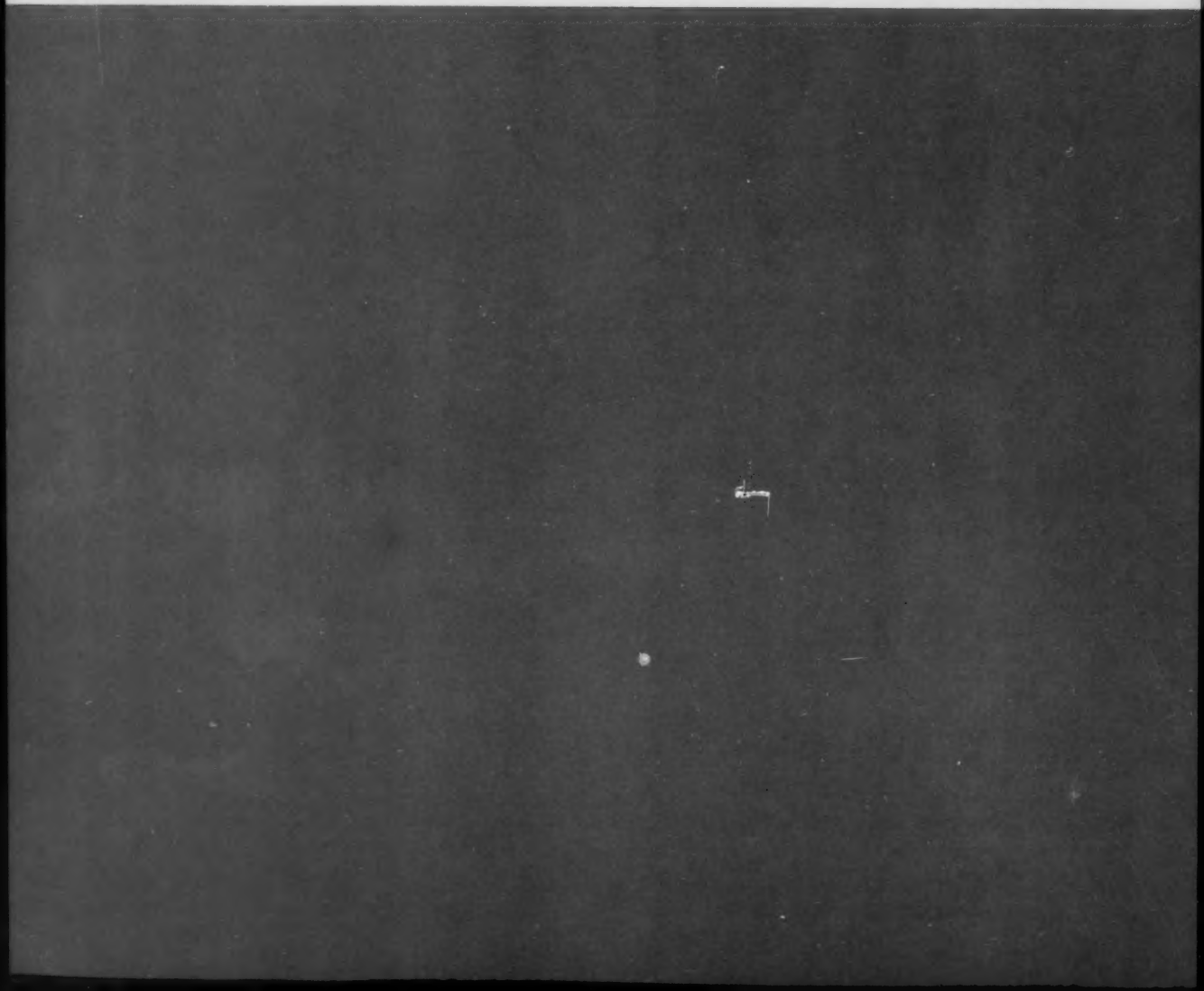
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